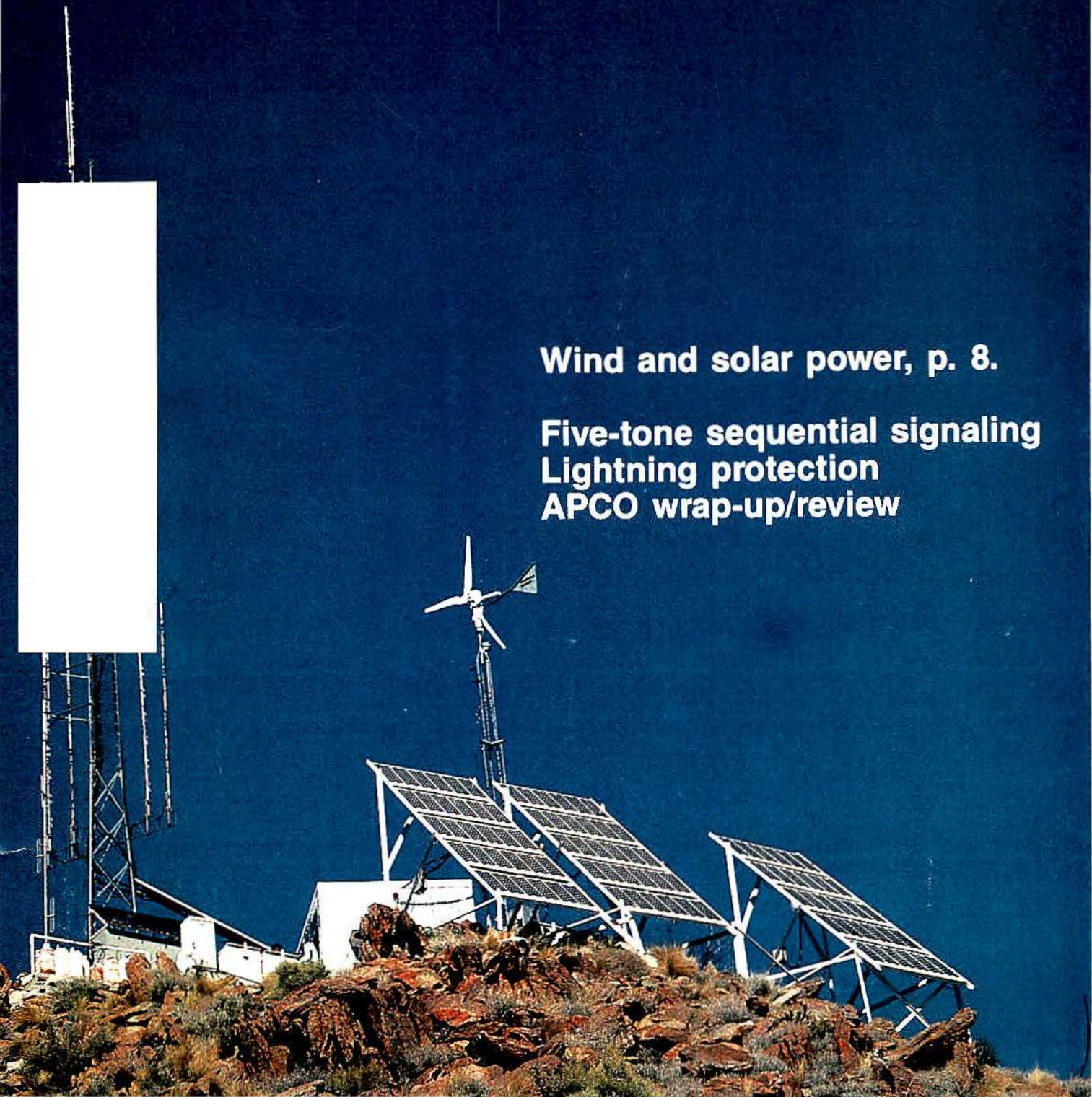


Mobile Radio Technology

The journal of mobile communications technology

Wind and solar power, p. 8.

**Five-tone sequential signaling
Lightning protection
APCO wrap-up/review**





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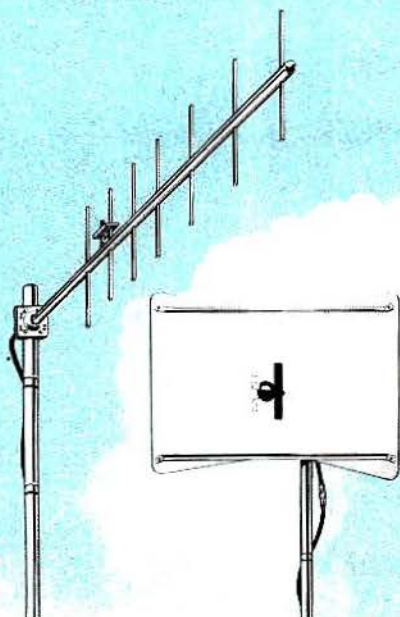
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features

8 Wind augments solar power at mountaintop radio site

Don Bishop

A wind-driven generator boosts an alternative energy system's reliability and extends battery life at a 50-repeater remote site.

16 Five-tone sequential boosts system capabilities

Frits P. Van Enk, Sigtone

Five-tone sequential signaling supports automatic number identification, selective calling and status registration.

24 Lightning protection devices: How do they compare?

Dr. Mark M. Drabkin and Roy B. Carpenter Jr., Lightning Eliminators and Consultants

At least five criteria help to define specific equipment configurations.

34 APCO wrap-up/review

Don Bishop

Public safety radio's trade association comes to grips with growth.

departments

Editorial

Short-spacing, 220MHz and a trunking standard.

6 Letters to the editor

Forest Service may need outside help.

38 News

Glenayre's buying spree.

48 ACT update

Do you speak 800MHz?

52 Regulating technology

Public safety wrestles with a trunking standard.

64 New products

Data Capture, Midian Electronics and Ritron are the "Readers' Choice."

84 Literature

86 Feedback

Readers order equipment at trade shows.

87 People

Jack Hurley becomes Glenayre president.

88 Calendar

SIRSA holds its annual meeting.

89 Classified ads

96 Ad index/hotline

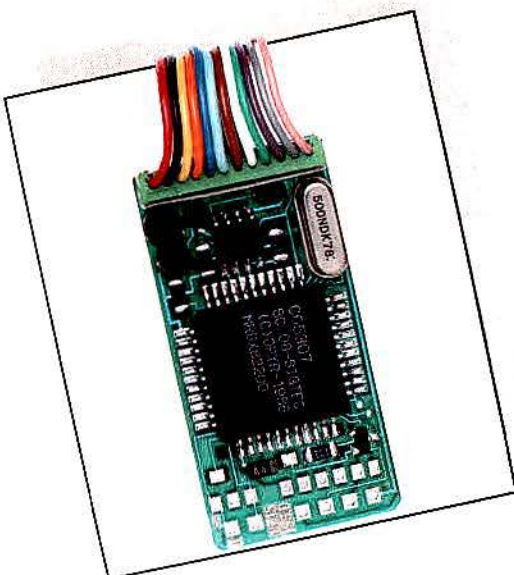
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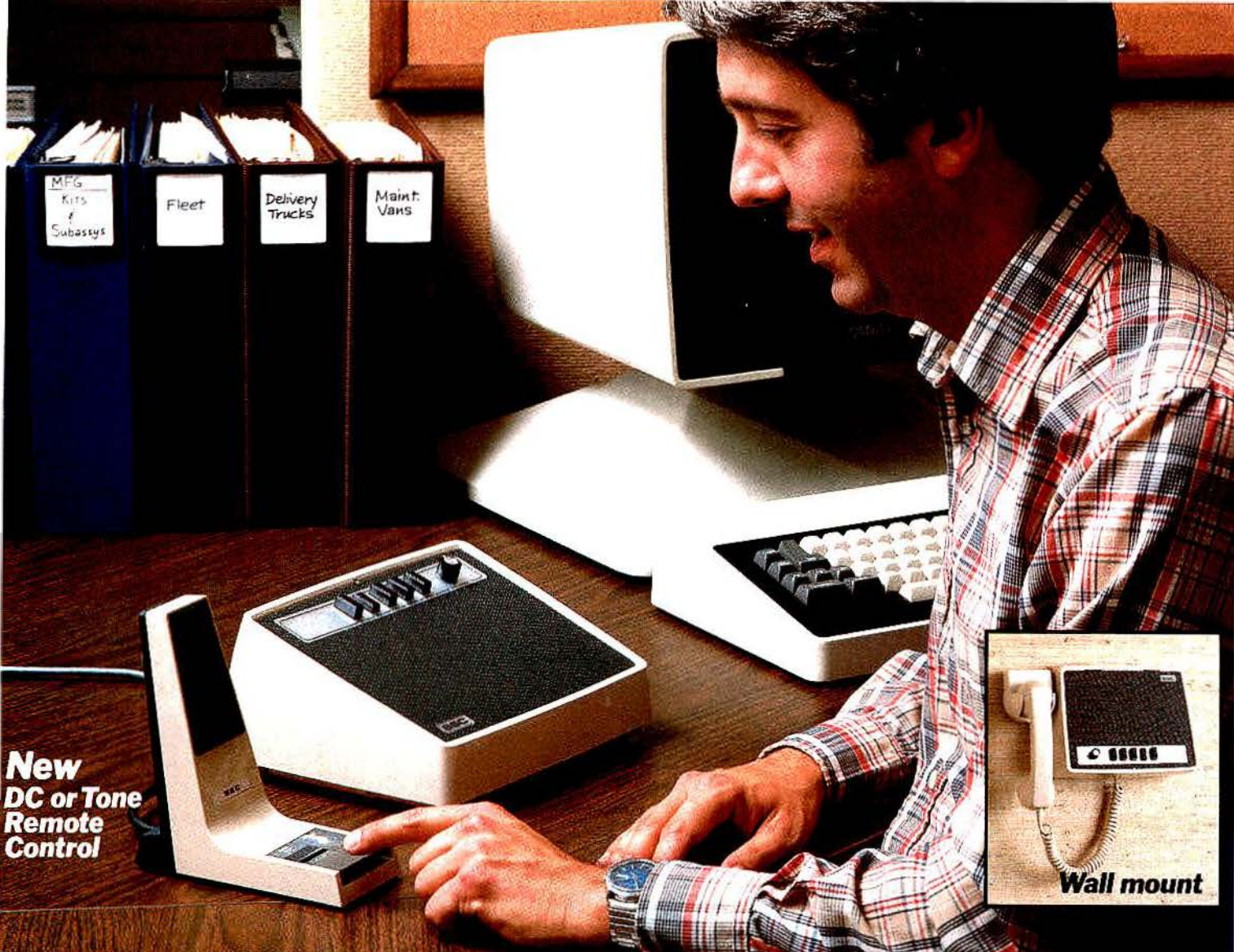
page 8



page 16

On the cover: Wind augments solar at Racom Services' Sierra Estrella site near Phoenix. See article on page 8.

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Scanning . . .

An industry is born

For years, broadcast consulting engineers have reaped the rewards of a frequency assignment policy that requires careful, expensive engineering calculations.

The policy involves the calculation of interference contours for AM radio and FM educational radio signal coverage areas. In the case of AM, it includes the design of sometimes quite complex directional antenna systems.

The FCC will give birth to a similar engineering industry if it approves a request jointly filed by the National Association of Business and Educational Radio (NABER) and the Special Industrial Radio Service Association (SIRSA).

The two associations have asked the FCC to permit "short-spacing" systems in the 800MHz frequency pools in major urban areas. "Short-spacing" involves the calculation of interference contours to ensure co-channel, adjacent systems on exclusive channel assignments do not interfere with one another. The assurance relies on terrain shielding or directional antennas.

Carefully implemented, short-spacing will work reasonably well. Interference complaints are inevitable, even with strict geographic separation guidelines.

The object is to shoe-horn in more systems without causing interference. One result will be the birth of an industry.

No champagne yet

Amateur radio users are down, but not out. Maritime radio service users squeaked by unscathed. Land mobile radio won 2MHz for narrowband systems at 220MHz.

But the champagne didn't flow Aug. 4 at SEA Inc. and Aerotron when the FCC announced its decision to delete the amateur authorization at 220MHz to 222MHz and hand it over to land mobile radio users, who will share it with government users.

Amateurs undoubtedly will petition for reconsideration. The petition is likely to be denied. After it is, the FCC will issue a notice of proposed rulemaking to adopt rules for using the frequencies.

A comment period will follow. Because the proposed use of the band is not limited to amplitude companded single-sideband (ACSSB), lengthy deliberations may follow.

Then the FCC will set forth the rules, and will begin accepting license applications. Provided the rules make room for ACSSB—which seems likely—then champagne will flow at Aerotron and SEA Inc., the only manufacturers of land mobile ACSSB equipment.

By the way, ACSSB licenses continue to be issued for business radio frequencies in the VHF highband, and represent the only opportunity to use VHF highband business radio repeaters.

* * *

Public safety trunking

The issue of whether the FCC should require the use of a standard protocol for trunked public safety radio communications systems continues to be debated. It is the subject of an FCC notice of inquiry. The issue also was covered during three panel sessions held during the Associated Public-Safety Communications Officers' 54th Annual National Conference Aug. 8-12 in Little Rock, AR.

General Electric's program manager of public safety trunking and Voiceguard, Jeffrey Childress, gave a succinct list of alternatives that users, manufacturers and regulators ought to consider to achieve "interoperability":

- (1) standardization.
- (2) use of proposed and existing mutual aid channels.

(3) translators or gateways.

(4) multimode radios.

A combination of these alternatives, as well as ideas submitted in response to the notice of inquiry, might form other solutions.

At stake is the licensing of public safety frequencies allocated July 24, 1986. Trunking standard proponents pressed their case forcefully enough to cause the FCC to reexamine the issue. By April 1987, it had been deliberated and rejected by the National Public Safety Planning Advisory Committee in favor of the use of mutual aid channels to achieve "interoperability." The FCC had accepted the committee's recommendation.

The FCC ought to consider whether a trunking standard is appropriate. In the meantime, the commissioners ought not to block the issuance of licenses to users whose needs are critical to present efforts to protect life and property.

—Don Bishop

PRIVACY

Volume 1, No. 3

NEWS
from
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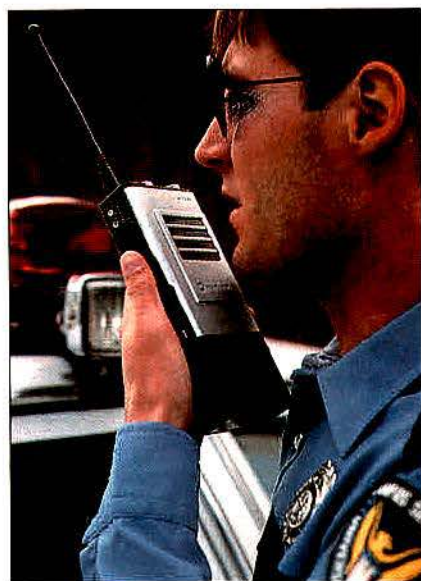
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During my 27 years with the U.S. Forest Service, I gained an in-depth knowledge of the technical requirements, as well as the many steps necessary, to classify a site for electronic use on U.S. Forest Service land. During fiscal year 1985-1986, I worked with other staff members to determine equitable fees for electronic sites. I believe we were much closer to establishing truly market-related fees than what was developed later.

Regarding the March 1988 editorial, "Forest Service Asks for 25% of Gross—or More," J.H. Ericksen's points are valid. From what I have been able to determine, the aborted fee schedules were developed by realty appraisers without input from the radio communications community. I have observed an attempt that compounds the error—an attempt to impose a fee schedule in the Appalachian Mountains upon a site in the coastal plains, hundreds of miles away and far beyond comparable conditions.

The Forest Service and other governmental agencies should at least involve their own in-house communications personnel in the development of fee schedules. Because of the loss of experienced radio communications people and the subsequent replacement by computer types within the Forest Service, it may require assistance from outside the agency.

Donald Sanders
Telecommunications Specialist
Lawrence Behr Associates
Greenville, NC

Regarding my article, "Why RPC1 (POCSAG) is the International Standard" (May 1988), unfortunately a most serious error crept in and I would be grateful if it could be corrected while the article is in readers' minds. Under "Accuracy" (page 36, center column) it should read, "At levels above that range, the accuracy is substantially 100% . . ." The error completely reverses the meaning. I hope that this was not my fault,

but I apologize in case it was.

Readers also may wish to know that British Telecom (BT) Radiopaging now has many thousands of 1,200bps RPC1 alpha message pagers on its system. When I last inquired, BT had more than 400,000 RPC1 pagers (tone-only, numeric and alpha message) on its system and it still is growing rapidly.

R.H. Tridgell
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Getting volunteers to cooperate with emergency service officials is difficult.

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The journal of mobile
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Wind augments solar power at mountaintop radio site

The need for the highest degree of reliability spurred Racom Services Corporation to combine wind, solar and battery power at its Phoenix, AZ, radio site. Fifty repeaters use the alternative energy source.

By Don Bishop
Editorial Director

"It works."

Charlie Bonifasi, vice president and general manager of Racom Services Corporation, Phoenix, AZ, said that is the reason why his company uses wind, solar and battery power as the primary power source for its mountaintop radio repeater site.

Behind the simple statement, "it works," is the notion of *grade of service* or *reliability*. "What is important to our customers is that the repeaters work whenever they need them. That is why I went with solar power to begin with. It works. And keeps on working."

In April, a wind-driven generator was added to the power system as part of an upgrade that included replacement of the 10-year-old batteries. Why a wind-driven generator? "I am a believer," Bonifasi said.

"When we installed the photovoltaics (solar panels) 10 years ago, the construction project was extensive," he explained. "I spent a week during the summer on the mountaintop, living in a tent. The wind blew all night long. It results from the natural phenomenon of hot desert air rising at night." During the summer, the site receives power from the photovoltaics during the day and from the wind-driven generator at night.

Cloudy days are rare in the summer, but when clouds come they usually are associated with a windy storm—once again, the wind-driven generator takes up where the photovoltaics leave off. During cloudy days in the winter, wind once again is common.

Clint Coleman, vice president of en-



A helicopter airlifts the batteries, still in their original pallets. The helicopter cannot land because the batteries occupy its helipad.



Workers build a raceway to carry the batteries to the building. They salvage the lumber from the battery pallets.

gineering at Northern Power Systems, Moorhead, VT, worked on the upgrade project. He said the photovoltaic system at the site is unusually large, with a 2.5kW capacity. The wind-driven generator's capacity is 1kW.

Battery life

Yet the wind-driven generator offers an enormously important benefit in extending battery life, Coleman said. He said most customers who use large photovoltaic arrays do not recognize the value in adding a small wind-driven generator. But the value lies in the nature of renewable energy itself.

Coleman explained that solar energy is regular and moderate. Photovoltaic output begins from zero at sunrise, rises to a peak at mid-day and returns to zero at sunset. During periods of little or no sunshine, the load draws more power from the batteries than the photovoltaics replace. The batteries are reduced to something less than 100% charge.

Battery life is greatest when the batteries are kept at or near 100% of ca-

capacity, or at least returned to that state quickly following a partial or deep discharge.

"The windmill is a much more dynamic source of energy than photovoltaics," Coleman said. "You can get it running at rated output for 50 hours straight. You can charge a partially charged battery up to full charge. By keeping it at full charge, you extend its life dramatically. Photovoltaics cannot do that because solar energy is not dy-

namic. The windmill can. It is especially valuable because when a storm comes through, the potential exists to restore the batteries to full charge."

Coleman said battery manufacturers explain how well their batteries can tolerate deep discharges. But users may not be aware that batteries are degraded when left at a low state of charge for days or weeks. "Accumulated hours at less than 100% charge really cause a loss of battery life," Coleman

Battery life

Keeping the batteries at or near a 100% state of charge greatly increases their life. Two ingredients of hybrid alternative energy system design contribute to battery life:

☐ **Dynamic power source**—A dynamic power source, such as a wind-driven generator, can bring batteries to a state of full charge rapidly, especially during periods when photovoltaic output may be low or zero.

☐ **Computerized controller**—Sophisticated power controllers that provide computer printouts of the battery bank's state of charge help to manage and maintain the power system. The site history a computerized controller develops helps to manage the load, or the power source, to maintain battery charge.

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Many of you are of small businesses, as are we, and are aware of the tremendous penalties—time, fines for lateness of payment, paperwork (reporting) burden, etc.—imposed by big government.

As a father and grandfather, I am deeply ashamed of the 'debt burden' we are leaving our offspring. Knowledgeable leaders, unfortunately in the minority, have offered legitimate methods of accomplishing necessary welfare and military defense with substantial reductions in outlay; ignored by a fat bureaucracy and a fatter congress.

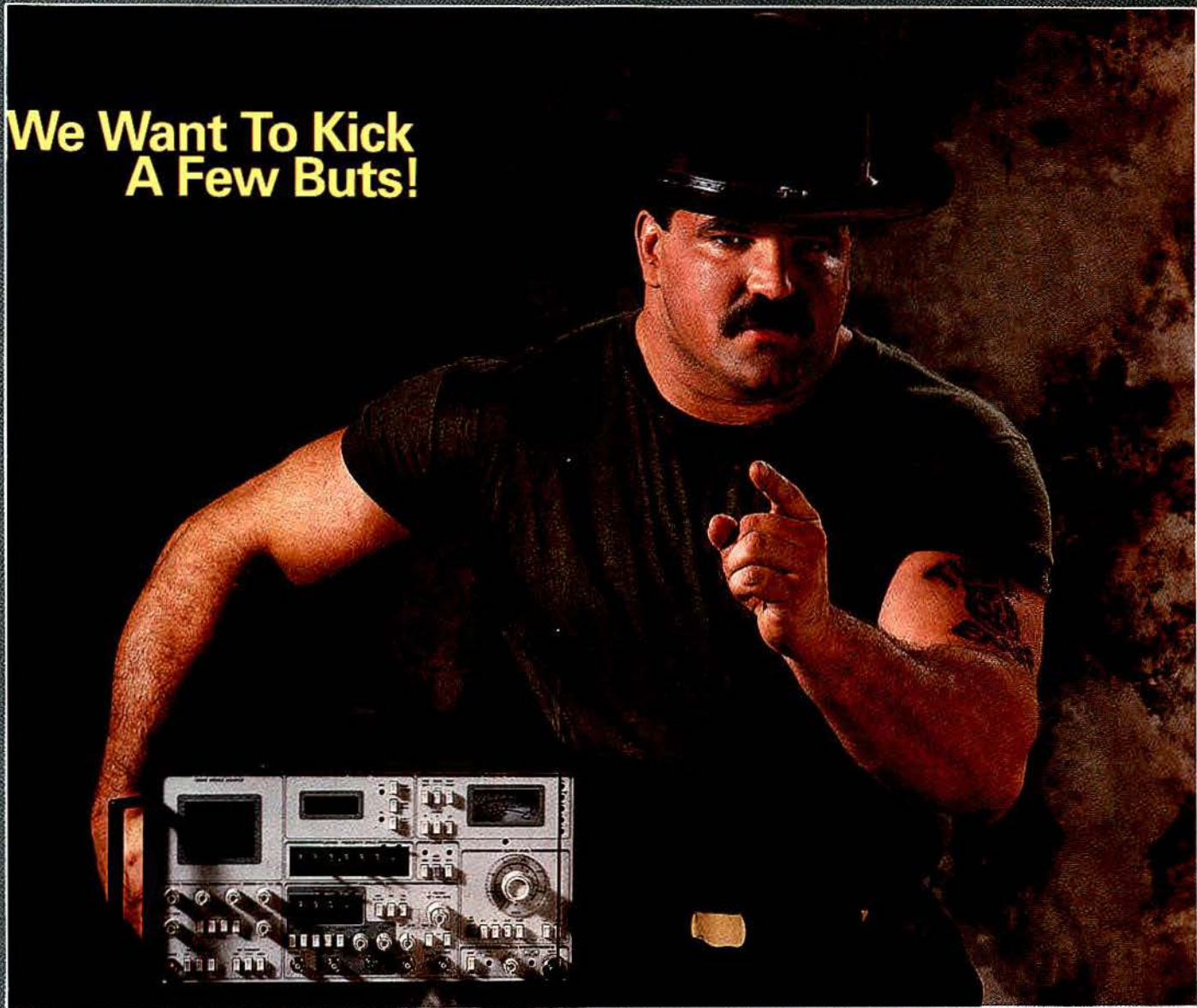
I respectfully submit that it is up to we conservatives to get out and educate the 'apolitical, uninformed, misinformed and economically illiterate' that we must get rid of **spendthrift congressmen**, from 'either side of the aisle'. We **must vote** for those who promise to reduce spending and oust those who won't or who "leave themselves an 'out'". Otherwise we, and consequently the whole country, will end up **bankrupt**.

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emphasized.

As part of the upgrade, a battery bank with a 16,000Ah capacity was installed during three days of work. The batteries were airlifted to a pad 100 feet from the shelter. From there the 500-lb. battery modules were rolled on pipes along a wooden sidewalk built for the purpose between the pad and the shelter.

Absolyte batteries were chosen, Bonifasi said, "because the site has a limited area and a small shelter. The installation is on a mountain peak, and the ground slopes down sharply in all directions. Absolyte batteries can be laid on their sides and stacked, conserving floor space."

Control system

A computerized power control system helps to measure the state of charge. It integrates the flow of current to the load with the flow of current from the photovoltaics and the wind-driven generator (and a standby, fuel-powered generator) to calculate the state of charge. "The customer has real-time computer print-outs of system status and performance," Coleman said. Aside from the immediate advantage of knowing the present state of charge, the site manager benefits from the development of a site history. "It allows the customer to determine how much more equipment could be installed without overloading the site," Coleman said.

The site history helps in planning and scheduling maintenance. A clear picture of site performance allows a maintenance plan to be developed and the proper tools to be selected prior to arranging for what might be expensive transportation to the site. The Phoenix site, for example, is reached either by a difficult, six-hour hike or by helicopter transport.

"The computer history may indicate that a site has problems with a low state of charge only at certain times of the year. When maintenance is scheduled for those times, the batteries can be tended at the same time that regular maintenance is performed," Coleman said.

Redundancy

Certain redundancies were retained or built into the upgrade: a fuel-powered generator, dual rectifiers and the wind-

driven generator. "For high-reliability sites, an on-demand power system (the fuel-powered generator) is advantageous for two reasons," Coleman said. "If you

ever have a fault, you can turn it on, or it turns on automatically, to keep the site in service. Also, it provides ac power for service employees. It is common to



Battery modules weighing in excess of 500 pounds each begin to be moved along the wooden raceway toward their mounting positions alongside the equipment shelter.



Using basic tools—the inclined plane of the raceway and rollers of pipe material—workers push and pull the batteries across 100 feet of rock to the shelter.



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Your customers will find the Panasonic name is something they can rely on whether they're on the road, or off the road.



Panasonic



The work crew uses a makeshift A-frame and come-alongs to set the batteries into position. Absolyte batteries may be stacked on their sides to save floor space.

begin with the fuel-powered generator as a basic component and then to reduce the reliance on it with other renewable energy sources."

Two rectifiers were installed because rectifiers sometimes fail. Rectifier failure sidelines the fuel-powered generator. "The use of two rectifiers really boosts the reliability," Coleman said.

The wind-driven generator, aside from helping to maintain the batteries at a higher state of charge, serves as a redundant energy source.

From Bonifasi's perspective, the reliability of the power source represents a competitive edge. "The key to the two-way radio business is grade of service," he said. "Cellular mobile telephone service has created an awareness among users that highly reliable service is available. Two-way radio system operators who do not put money back into their businesses to support a competitive grade of service will see their businesses evaporate."



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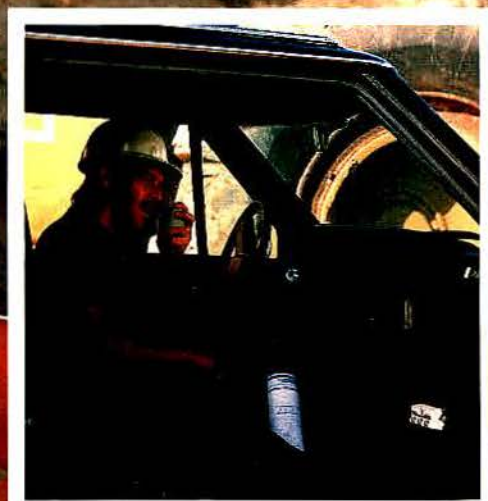
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Circle (12) on Fast Fact Card

Five-tone sequential boosts system capabilities

One of the world's most popular mobile radio signaling formats, five-tone sequential, supports automatic number identification, selective calling and status registration. Encoder-decoder performance is important.

By Frits P. Van Enk

"Minimum Requirements for CTCSS Signaling," an article printed in the November 1987 issue, examines performance requirements for continuous-tone controlled squelch system signaling. The article explains why it is vital that the CTCSS function does not degrade radio performance, and it lists minimum CTCSS performance levels to achieve that objective.

The article explains CTCSS may provide several radio system functions, including limited selective-calling capability. The Electronic Industries Association CTCSS standard, EIA-220A, stipulates:

The purpose of the defined system is to minimize the annoyance of hearing communications directed to others sharing the same carrier frequency. By using a specific tone, each user may code his carrier to prevent his reception of audio signals from any uncoded or differently coded carriers.

The actual number of available CTCSS tones (or *address codes*) is limited. Moreover, CTCSS has technical limitations, such as incompatibility with some landline or radiolink systems that are not transparent to subaudible signaling. It is no surprise that land mobile radio growth, combined with new technology, has led to the use of more elaborate selective-calling systems—five-tone sequential, for example.

The EIA, the International Radio Consultative Committee (CCIR) and

most European mobile radio regulatory authorities have adopted the five-tone system as the standard for private mobile radio signaling. Five-tone signaling offers advantages and functions that have become almost indispensable. A mobile radio system without it is relatively inefficient.

Five-tone principles

Figure 1 below shows the basic five-tone sequential message format. It begins with a short period of silent carrier (*lead-in delay*) that enables the

system to stabilize before the tone sequence begins. The sequence consists of five tones (*tone periods*) of equal duration.

International standards precisely define tone frequencies that represent each digit from 0 to 9, as well as other characteristics such as decoder passband and stopband limits. To avoid ambiguity in the decoding process, a *repeat (R)* tone is used when adjacent digits are identical. For example, 10441 is coded 104R1; 10444 is coded 104R4.

A *group tone (G)* is used when groups

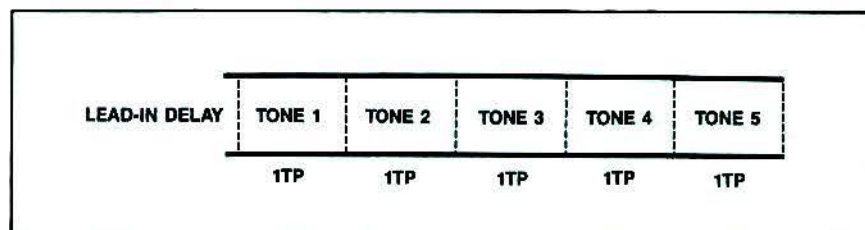


Figure 1. Basic five-tone sequence format.

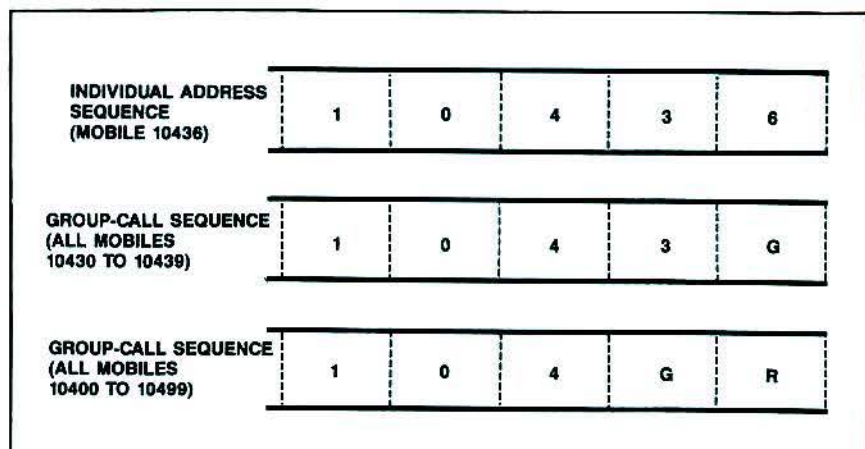


Figure 2. Typical five-tone group-call sequences.

Van Enk is the product manager for Sigtone in Los Angeles.

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of users are called. Decoders with group-call capability recognize individual address tone frequencies, as well as the group-tone frequency, as shown in Figure 2 on page 16.

Performance characteristics

The most important five-tone signaling performance characteristics are:

- **Decode sensitivity**—The lowest sig-

nal-to-noise ratio (SNR) that gives a reliable decoder response. The higher the decode sensitivity (i.e., the lower the minimum operating SNR), the better the system performance.

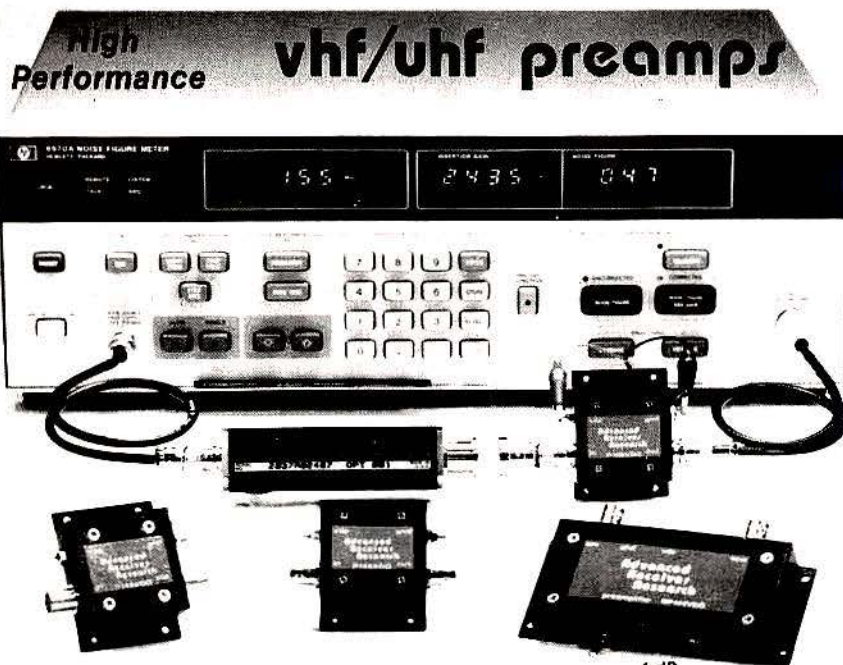
- **False decode probability**—The probability of a positive decoder output response without prior reception of a correct five-tone sequence (also known as *falsing*).

Falsing may be caused by poor decoder quality. For example, under certain conditions, an inferior decoder coded to address 71543 may respond to a 71542 sequence.

Falsing may occur during heavy traffic when selective calls may overlap one another. Noise, interference and heterodyne effects may lead to falsing.

Controlling falsing almost directly conflicts with the objective of the highest possible decode sensitivity.

- **Decoder input dynamic range**—The



A wide decoder input dynamic range is essential to guarantee optimum performance under field conditions.

ability of a decoder to respond to a wide range of input signal levels. Many decoders perform reasonably well under standard input level conditions. But to obtain a real performance measurement, the input level must be varied.

Dynamic methods should be used, along with static methods. Dynamic input test conditions more closely simulate typical mobile environment operating conditions. Some decoders fail under such conditions. For example, wide input level fluctuations seriously may affect decode sensitivity. The actual passband or stopband response or both may be degraded to such an extent that the falsing level becomes unacceptable.

When varying decoder input levels are combined with other signal characteristic variations that may occur in the field (such as input signal frequency and timing variations), many decoders have high failure rates. A wide decoder input dynamic range is essential to guarantee optimum performance under field conditions.

Practical implementation

The application of programmed digi-

| Receive only | Freq. Ranges (MHz) | N.F. (dB) | Gain Comp. (dB) | 1 dB (dBm) | Device Type | Price |
|------------------------------------|----------------------------|-----------|-----------------|------------|-------------|----------|
| P30VD, P35VD, P40VD, P45VD | 30-35, 35-40, 40-45, 45-50 | <1.3 | 15 | 0 | DGFET | \$ 44.95 |
| P30VDG, P35VDG, P40VDG, P45VDG | 30-35, 35-40, 40-45, 45-50 | <0.5 | 26 | +12 | GaAsFET | \$109.95 |
| P150VD, P160VD, P170VD | 150-160, 160-170, 170-180 | <1.5 | 15 | 0 | DGFET | \$ 44.95 |
| P150VDA, P160VDA, P170VDA | 150-160, 160-170, 170-180 | <1.1 | 15 | 0 | DGFET | \$ 56.95 |
| P150VDG, P160VDG, P170VDG | 150-160, 160-170, 170-180 | <0.5 | 24 | +12 | GaAsFET | \$109.95 |
| P450VD, P460VD | 450-460, 460-470 | <1.8 | 15 | -20 | Bipolar | \$ 49.95 |
| P450VDA, P460VDA | 450-460, 460-470 | <1.2 | 16 | -20 | Bipolar | \$ 74.95 |
| P450VDG, P460VDG | 450-460, 460-470 | <0.5 | 16 | +12 | GaAsFET | \$109.95 |
| P800VDG, P830VDG, P860VDG | 800-830, 830-860, 860-890 | <0.6 | 19 | +12 | GaAsFET | \$119.95 |
| Inline (rf switched) | | | | | | |
| SP30VD, SP35VD, SP40VD, SP45VD | 30-35, 35-40, 40-45, 45-50 | <1.4 | 15 | 0 | DGFET | \$ 74.95 |
| SP30VDG, SP35VDG, SP40VDG, SP45VDG | 30-35, 35-40, 40-45, 45-50 | <0.55 | 26 | +12 | GaAsFET | \$139.95 |
| SP150VD, SP160VD, SP170VD | 150-160, 160-170, 170-180 | <1.6 | 15 | 0 | DGFET | \$ 74.95 |
| SP150VDA, SP160VDA, SP170VDA | 150-160, 160-170, 170-180 | <1.2 | 15 | 0 | DGFET | \$ 86.95 |
| SP150VDG, SP160VDG, SP170VDG | 150-160, 160-170, 170-180 | <0.55 | 24 | +12 | GaAsFET | \$139.95 |
| SP450VD, SP460VD | 450-460, 460-470 | <1.9 | 15 | -20 | Bipolar | \$ 79.95 |
| SP450VDA, SP460VDA | 450-460, 460-470 | <1.3 | 16 | -20 | Bipolar | \$104.95 |
| SP450VDG, SP460VDG | 450-460, 460-470 | <0.55 | 16 | +12 | GaAsFET | \$139.95 |

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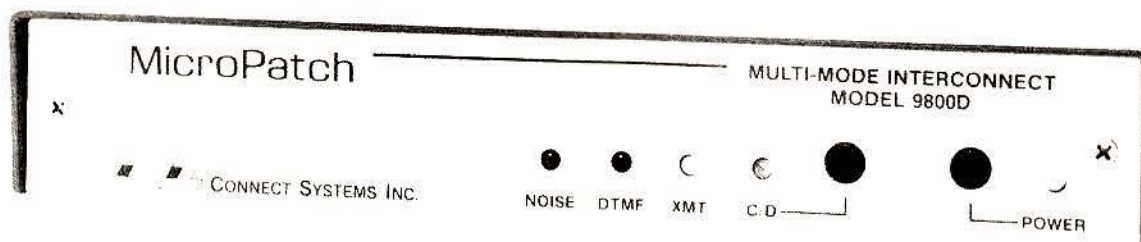
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The 9800 also provides complete **remote base** capability extending the use of the base station or repeater to any telephone.

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tal logic (Digital Analysis decoding) to analog five-tone signals has yielded a proprietary digital signal transformation immune to false decodes. Analytical decoding offers an ideal way to implement five-tone signaling. The decoder analyzes received tone sequences according to several criteria. It carries out extensive timing, frequency and energy level checks before responding with a positive decode output.

False decode probability is nil in practical applications. Actual passband and stopband frequency response curves are almost perfectly square. Analytical decoding responds reliably and consistently to a tone of the correct frequency but does not respond to a tone of an incorrect frequency, almost regardless of the actual signal input level.

Digital, analytical decoding lets tone periods be shortened to as little as 20ms with negligible performance loss, further improving signaling speed without compromising decode sensitivity and falsing.

The decoding method delivers a de-

used. To a lesser extent, frequency-shift keying (FSK) and phase-shift keying (PSK) also are used.

Table 1 on page 22 gives an overview of important system characteristics for the various signaling methods.

Some precautions in using the table:

- Although five-tone signaling is an ideal signaling method for mobile radio applications, not all implementations of the method result in products that perform equally well.

- Five-tone signaling is advocated as the best method for mobile radio signaling applications, but it is not possible to conclude that any other signaling system is inferior in all respects.

- The comparisons are based on a "mix" of basic fundamental characteristics and actual practical product implementations found on the market.

For the purposes of the table, five-tone signaling performance is based on the application of programmed digital logic to analyze the five-tone signals. For the other signaling methods, "across-the-board" performance levels based on published figures or observations of alternative signaling products and methods are used.

Applications

Five-tone sequential signaling can be used for several applications, including automatic number identification (ANI), selective calling and status registration.

□ **ANI**—In an ANI system, a short five-tone signal corresponding to the mobile unit's identity is transmitted automatically each time the mic push-to-talk switch is pressed. Five-tone ANI does not interfere with normal speech. General system operation remains unchanged. To add five-tone ANI to any mobile radio system merely requires the installation of small encoders within the mobile or portable units and the placement of a decoder and display unit at the base station.

The display of mobile or portable unit identification (and/or status) offers several advantages:

- immediate identification of nuisance callers.
- elimination of lengthy voice-call establishment procedures (because callers are identified visually and rapidly).
- positive identification, which may be useful especially in situations involv-

ing the safety of life and property.

- instant display of alarm or status functions that improve the radio system's operational efficiency.

- automatic recording by computer or printer of mobile traffic for statistical analysis and other fleet management purposes is possible.

□ **Selective calling**—With selective calling, a specific individual in a communications network may be alerted without unnecessarily involving other users. Each user is allocated a unique five-digit numerical identity. Users do not need to listen to unwanted channel traffic.

When the decoder receives a correct address code, an audible or visible alert, or both, indicates that a call has been received. The user's radio squelch opens and the conversation proceeds.

Aside from calling individual users, the entire user group or subgroups of users may be called simultaneously by using a group-call sequence.

Five-tone selective calling effectively eliminates the "party line" nature of a conventional mobile radio system by providing a "private telephone" style of communications capability.

Selective calling offers several advantages:

- The need for repeat calls is eliminated because a call to the mobile activates an audible or visible indication that a call has been received. Furthermore, the mobile unit automatically acknowledges receipt of the call.

- Annoyance is reduced because users do not hear fleet conversations, but rather hear only communications directed to them.

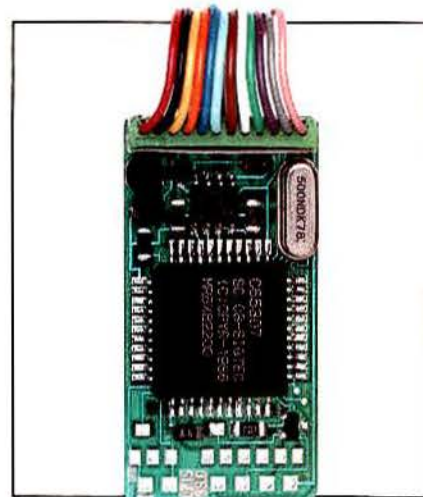
- Effective radio range is increased because the decoder responds under conditions too noisy to permit speech communication.

- Fleets may be subdivided (e.g., sales, service and management) and coded to communicate with their own base operators while sharing the same channel.

- Increased operating flexibility can be used to increase fleet efficiency.

- Streamlined communication boosts the number of users a channel can accommodate, increasing spectrum efficiency.

□ **Status registration**—Instead of sending oral status reports that may be



Sigtone's S1515 microminiature five-tone module for portable ANI and selective calling.

coder input dynamic range from 70dB to 80dB. The upper limit is determined by maximum device breakdown ratings rather than by basic decoder shortcomings.

Worldwide, five-tone sequential signaling probably is the most popular mobile radio signaling method. Nonetheless, dual-tone, multiple-frequency (DTMF, or *Touch-Tone*) and two-tone sequential signaling commonly are

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subject to misunderstanding or misinterpretation by the base station operator, mobile units may send status messages such as "in service" and "out of vehicle" in coded form. Specific "status" digits added to the five-tone ANI transmissions carry the status message. The messages are decoded and displayed at the base, together with the identity of the mobile. The combination provides the base operator with immediate and unambiguous fleet status information.

With a suitable "tone sequential to

RS-232" signaling translator, the radio system can be connected with a computer to expand operational efficiency even further.

Additional applications

Five-tone signaling is ideal for implementing general system control functions, such as repeater access, limited data signaling and remote control.

But even the most elegantly executed system will not deliver its promised performance if the basic encoder-decoder

signaling performance does not meet minimum performance standards. True digital decoding helps to meet technical performance requirements over the noisiest channels.

Combining the fundamental strengths and advantages of five-tone principles with superior encoding and decoding technology makes possible an extensive range of operational advantages, functions and capabilities.



Table 1—Important signaling performance characteristics of five-tone, DTMF, two-tone and FSK/PSK.

| | <u>FIVE-TONE</u> | <u>DTMF</u> | <u>TWO-TONE</u> | <u>FSK-PSK</u> |
|--|---|--|------------------------------|--|
| Required system transmission path | Operates over any voice-grade circuit. | Voice grade generally is OK, (provided frequency response is reasonably linear). | Voice grade generally is OK. | Critical requirements on system frequency response and phase delays. |
| Decode sensitivity | Superior (operates at nearly 0dB SNR). | Low (basically >6dB worse than five tone). | Very good. | Low (3dB to 12dB worse than five-tone). |
| False decode probability | Nil for all practical purposes. | Poor. | Medium to poor. | Similar to five-tone (if implemented properly). |
| Signaling speed | High (50 digits/sec at 20ms tone period). | Poor (typically 10 digits per second). | Very poor, extremely slow. | Data throughput is low for short data. (See Note 1.) |
| Dyanamic range | Superior (typically 70dB). | Usually poor (6dB to 20dB). | Depends on implementation. | Depends on implementation. |
| Intermodulation | Virtually none. | Usually a problem. | None. | None. |
| Twist | None. | Usually a problem. | None. | Can be a problem at higher signaling speeds. |

Note 1: FSK/PSK has a high "system stabilization" time overhead. (The system requires bit and word synchronization sequences and usually extensive cyclical redundancy checks.) For data messages of an extended length (e.g., limited or full-text transmission) this overhead becomes far less important. But for straight selective-calling applications, the message throughput of FSK/PSK is poor compared to five-tone.

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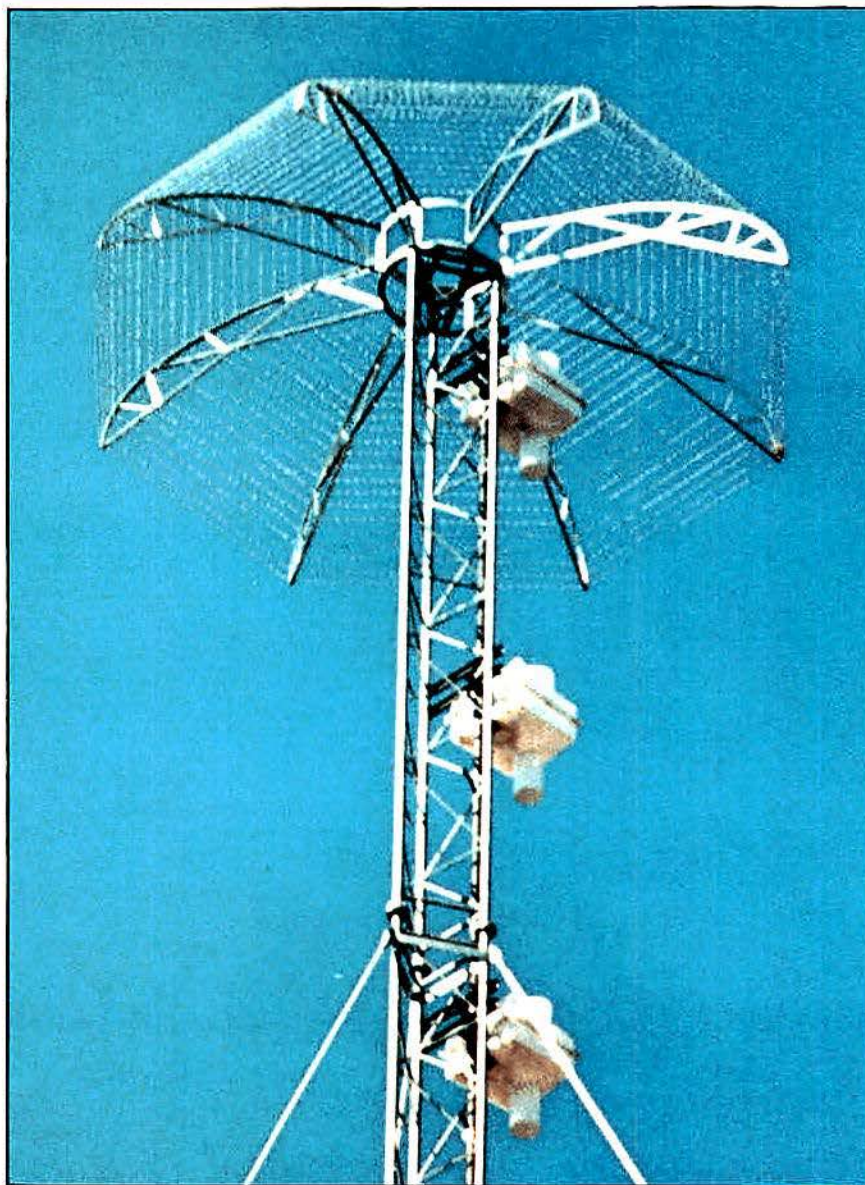
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Circle (17) on Fast Fact Card

Lightning protection devices: How do they compare?

Lightning protection devices that use multiple discharge points spread over a large area carry bigger ionization currents without arcing. At least five criteria help to define specific equipment configurations.



The hemisphere array is one configuration of several used to form custom-designed dissipative systems manufactured by Lightning Eliminators and Consultants. The frame supports concentric rings of wire, which in turn support dissipation points.

**By Dr. Mark M. Drabkin
and Roy B. Carpenter Jr.**

Protecting radio facilities against direct lightning strikes challenges engineers and laymen alike. Lightning protection technology can be classified into two categories:

- **Collection**—Most protection systems are intended to “capture” the stroke and divert it along a “safe” path. These systems usually include one or more lightning rods that attract lightning, diverting the surge current away from the protected facility.

Surge current flowing through grounding conductors and into the grounding grid generates a strong magnetic field. The magnetic field induces a high voltage on nearby electrical circuitry, underground communication system lines, telecommunication cables, and water and gas pipes.

- **Prevention**—Dissipative systems prevent lightning from striking by creating a *space charge* between the cloud and the protected object. The space charge, which has the opposite polarity of the charge in the bottom part of the thundercloud, decreases the electrostatic field around the protected object caused by the thundercloud charge.

Dissipation devices cannot *neutralize* a cloud charge fast enough to prevent all lightning strikes. An average surge current is about 20 coulombs. The average current from a single discharge point is about 100mA from a single, properly located point. The time required to dissi-

Drabkin has a Ph.D. in lightning protection and works as a consulting engineer with Lightning Eliminators and Consultants, Santa Fe Springs, CA. Carpenter, who holds the relevant patents, founded the company and serves as a consultant.

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Design criteria

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- ☐ The distance between adjacent points.
- ☐ The shape of the dissipator.
- ☐ The size of the grounding electrodes and the deployment and dimensions of the grounding grid.

pate a 20C charge from one point is:

$$T = Q/(i \times 3,600 \text{ seconds})$$

where

T = elapsed time in hours

Q = thundercloud charge in coulombs

i = discharge current in amperes per second

3,600 seconds = number of seconds in an hour

For example, with 20 coulombs of charge and 100mA of discharge from a single point:

$$T = (20C)/[(100 \times 10^{-6} \text{ A/sec}) \times 3,600 \text{ secs}]$$

$$= 20/(0.0001 \times 3,600)$$

$$= 20/0.36$$

$$= 55.6 \text{ hours}$$

It would take a single, isolated point more than 56 hours to neutralize a 20-coulomb charge. Thousands of points, isolated from one another, would have to be deployed to affect the cloud's charge and prevent a single lightning strike. Moreover, a single thundercloud cell may deliver multiple strikes during its relatively short life.

Lightning rod

The lightning rod's function encom-

passes a two-stage process: creating a space charge and conducting surge current.

The first part of the process, creating a space charge, is the same as the dissipative system process. The space charge that forms around a lightning rod is strong enough to prevent lightning strikes from *relatively small, slowly accumulating* cloud charges and from *fast-moving* cloud charges.

The second stage begins when current that leaks from the tip of the rod exceeds a "critical value," initiating an arc or upward-moving streamer. Lightning occurs when ionized air near the lightning rod tip passes from a glowing to an arcing condition.

Dissipative system

From 10 μ A to as much as 10mA flows through a properly designed dissipative system into the surrounding air, creating a much stronger space charge than the one created by a lightning rod.

Although the lightning rod causes a high voltage to appear on nearby objects, the dissipative system does not. The current carried by a dissipative system flows continuously during a storm. On the other hand, current from a lightning strike may reach several hundreds of thousands of amperes, flowing in about 20 μ sec. Where lightning rods are used, surge and transient protection devices must be used and must be placed properly.

Dissipative system design involves:

- the number of discharge (dissipation) points.
- the height of each point above the main conductor and the material used to make them.

Dissipative systems

Several manufacturers make lightning protection equipment that includes multipointed metal terminals elevated into the air. Configurations include circular or straight brushes made of wire, spikes on a metal panel and barbed wire strung on frames. Various names are applied to the terminals and to the combination of components that comprise protection systems.

In the April 1988 issue, we printed the article, "Dissipation Arrays: Do They Work?" It since has become apparent that the various manufacturers do not enjoy a consensus of opinion about how the devices work, what they should be called and whether trademark rights apply to some of the names.

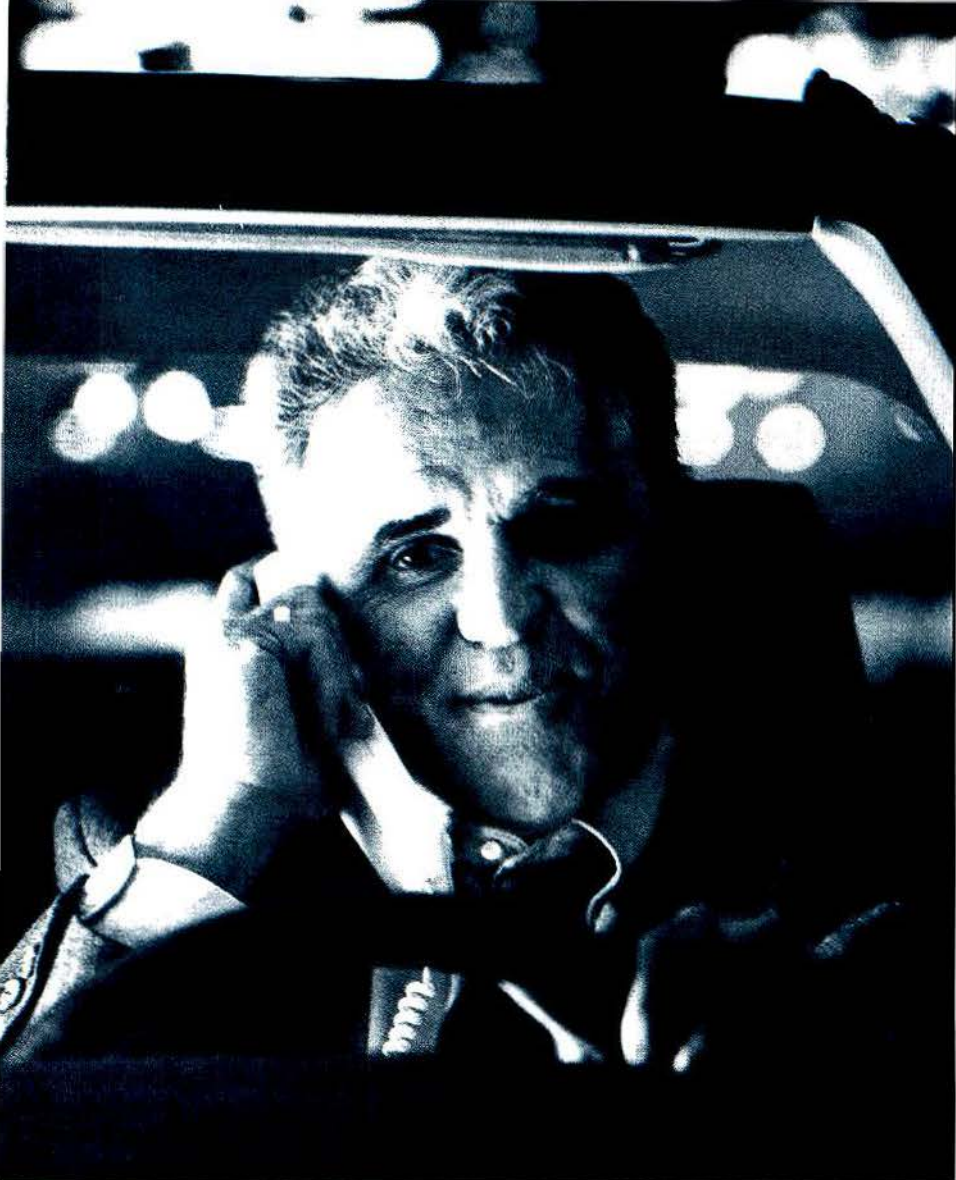
The dissipative system described in the accompanying article is manufactured by Lightning Eliminators and Consultants (LEC) under the name Dissipation Array system.

At the editor's discretion, a photograph of Lightning Deterrent Corporation's Verda Lightning Deterrent unit was used to illustrate the April article. Richard A. Tarney, the company's sales manager, wrote us, "...the Verda unit is not considered to be a dissipation array" unit. His letter reads that physics professors at the University of Wisconsin tell him that lightning rods with more than one point are considered to be "dissipation array" rods.

Roy B. Carpenter Jr., a consultant with and owner of LEC, wrote us, "'Dissipation Array' is trademarked by LEC. ..." He further wrote, "The design of an LEC Dissipation Array system is significantly different from the three or four companies that sell various forms of wire brushes or dissipators."

Mr. Carpenter submitted the accompanying article to help to make the distinction clearer.

—Don Bishop



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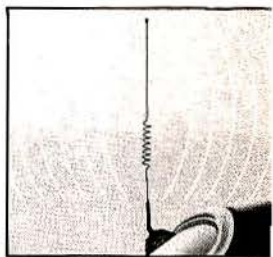
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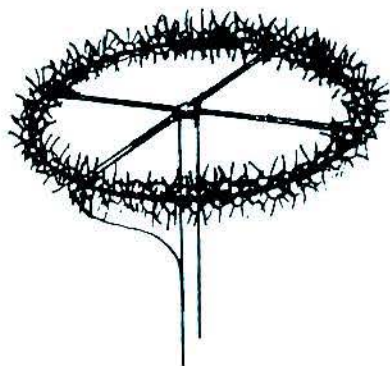
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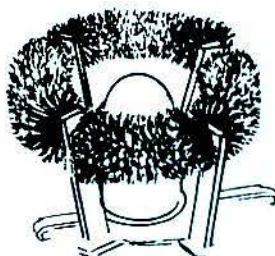
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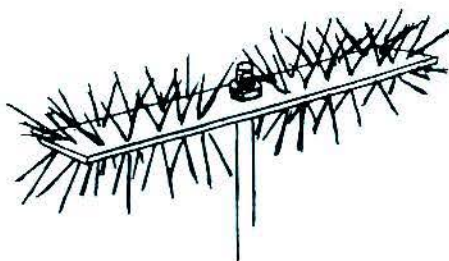




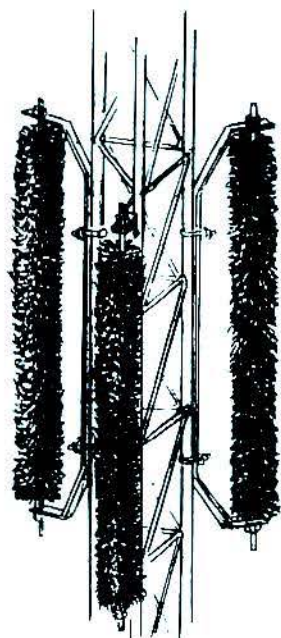
STATIC DISSIPATOR
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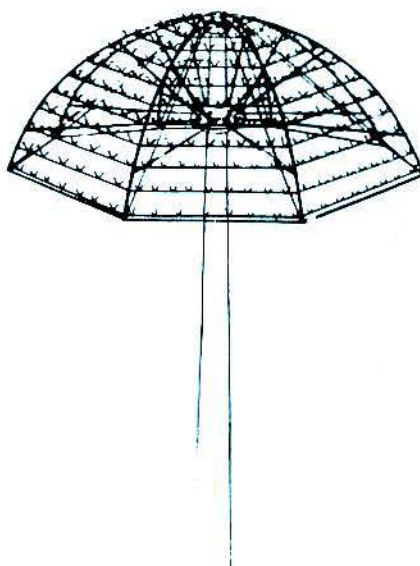
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Lightning Eliminators and Consultants

Pictured are the configurations of several manufacturers' multipointed metal terminals intended for mounting at elevated positions. *Editor's note:* The names of the units are those given by their manufacturers.

- the distance between adjacent points.

- the shape of the dissipator.
- the size of the grounding electrodes and the deployment and dimensions of the grounding grid.

A dissipative system uses multiple discharge points to create a stronger space charge. Up to a certain level, the higher the discharge current, the stronger the space charge and the better the protection. But concentrated discharge (enhanced ionization as from a wire brush) lets the dissipation stage pass from the glowing condition to the arcing condition, which encourages a lightning strike.

A true dissipative system controls the discharge; lightning rods do not; hybrids exercise limited control.

Design criteria for the dimensions of individual discharge points upon the dissipator, including height, diameter and spacing, result in maximum dissipation current and a uniform electrostatic field. No single point in the array of points discharges enough current to cause a transition from the glowing condition to arcing. Shapes that create uniform electrostatic fields resemble spheres, hexagons and umbrellas.

In any lightning prevention system, the optimum value of dissipation current per unit area cannot be exceeded without risking a direct lightning strike. The maximum dissipation current is:

$$I_{max} = k(E_{max}^2 - E_{min}^2)$$

where

E_{max} = the maximum potential gradient of the electrostatic field before its discharge initiates an arc

E_{min} = the potential gradient of the electrostatic field at which dissipation current flow begins

k = constant

Measurements made under laboratory conditions have shown:

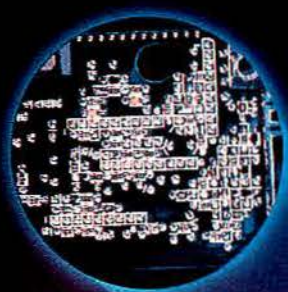
$$800V/m < E_{min} < 1,000V/m$$

$$(8 \times 10^{-14}A)/(V/m)^2 < k < (15 \times 10^{-14}A)/(V/m)^2$$

The value of I_{max} is affected by weather, location, equipment and structure configurations and the processes

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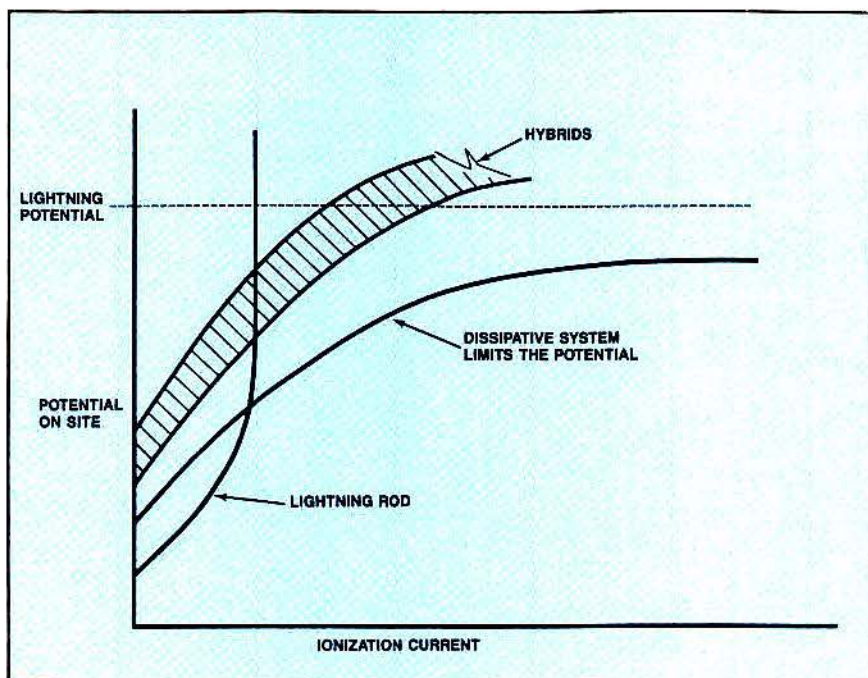


Figure 1. Performance differs between a dissipative system with discharge points arranged to conform to the electrostatic field and dissipators with highly dense configurations of points. The graph plots leakage current as a function of the electrostatic field caused by a thundercloud.

that form electrostatic charges in clouds.

Dissipators with points arranged in highly dense configurations do not conform to the electrostatic field; i.e., they are not arranged in forms similar to a sphere with large, smooth, exposed surface areas. A concentration of points is not enough to prevent lightning strikes. Each of the criteria listed on page 26 must be addressed.

Measurements we have made in a laboratory comparing current flow from multiple points vs. a single point show the separation between points has much to do with the electrostatic voltage level at which ionization begins and the discharge current level at any given electrostatic voltage.

Dissipators with highly dense configurations of points raise the ionization voltage somewhat higher than that of a conventional lightning rod. Thus, they decrease the probability of a lightning strike somewhat. But when the cloud's charge is large enough, these dissipators are subject to more powerful strikes that cause more damage.



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Experimental data we and others have gathered show that, for impulse voltages, total dissipation current roughly equals the sum of the currents from separate points when the distance between adjacent points exceeds certain critical values, which range from 4 inches to more than 24 inches, depending on other factors.

Figure 1 on page 30 shows why per-

formance differs between a dissipative system with discharge points arranged to conform to the electrostatic field and dissipators with highly dense configurations of points. The graph plots leakage current as a function of the electrostatic field caused by a thundercloud.

(1) A single lightning rod breaks into corona at about 10kV. Thereafter, current rises exponentially and soon ex-

ceeds the level that causes a streamer and a lightning strike results.

(2) The dissipative system breaks into corona later than the lightning rod does. Ionization current then rises rapidly. But the electrostatic voltage on the dissipator never reaches the level at which lightning would strike.

(3) Hybrid dissipators with highly dense point configurations also show a slower rise in electrostatic voltage compared to the lightning rod. The current flow rises to a higher level compared to the dissipative system with more widely separated points and optimum array shaping, eventually reaching the level that causes a streamer and resulting in a lightning strike.

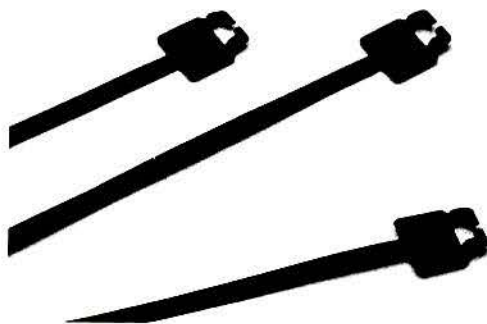
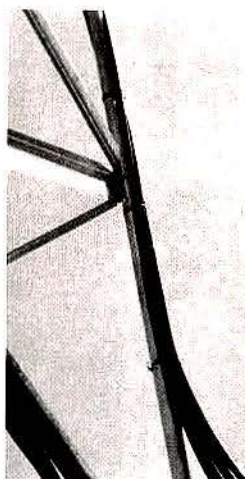
Performance differences are related to differences in the ionization current produced. To prevent a lightning strike, the protective system must be able to produce a large ionization current when the stroke is propagating but without creating a streamer that reaches the downward-moving step leader. A large, well-shaped dissipative area is required. The smaller the area, the poorer the performance.

Laboratory tests in a simulator demonstrated that two 30-inch strands of dissipation wire, separated by 10 inches, produced 275 μ A at 60kV. The wire brush with thousands of points only produced 80 μ A at the same potential.



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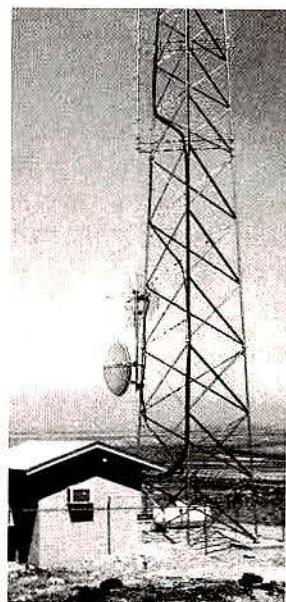
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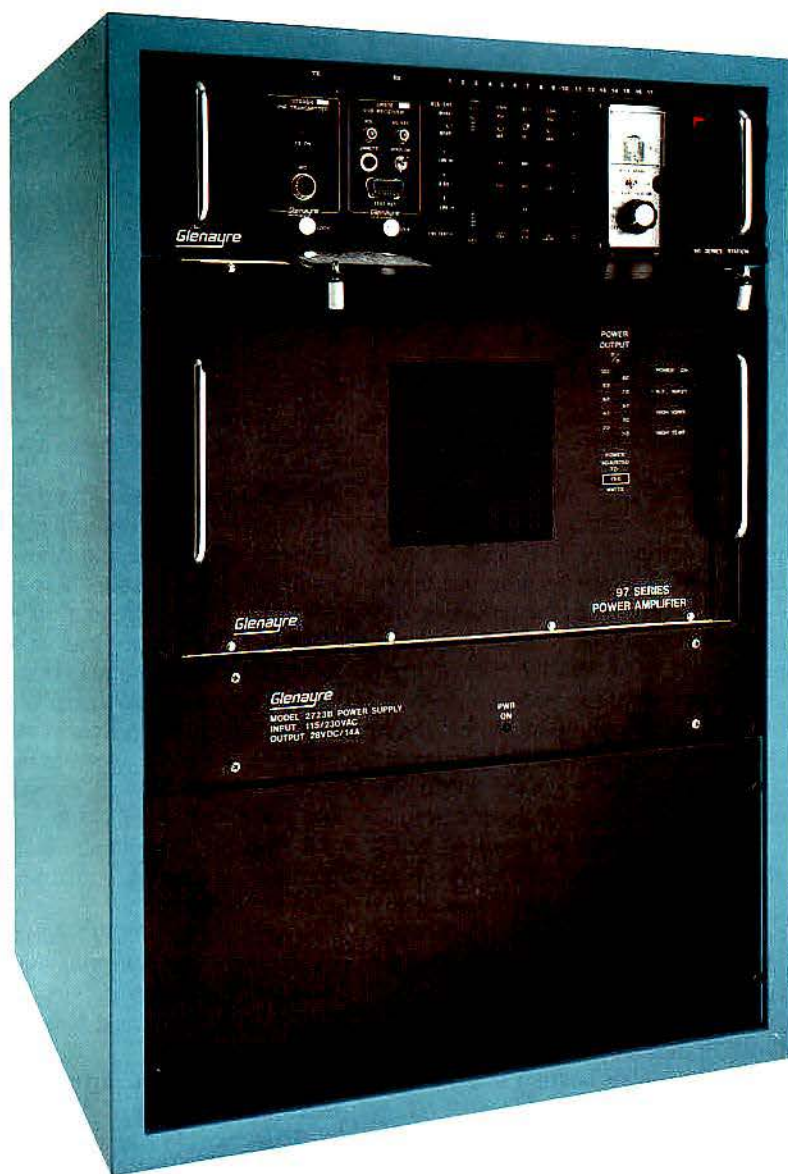
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APCO wrap-up/review

APCO continues to ride a steep growth curve as its budget expands to more than \$2 million. Suppliers and users struggle with the issue of trunking standards for new public safety 800MHz frequencies.

By Don Bishop
Editorial Director

Growth, and plenty of it—that was the message delivered by Associated Public-Safety Communications Officers (APCO) leaders to members who attended the association's 54th Annual National Conference Aug. 8-12 in Little Rock, AR.

Sessions where the issue of trunking standards for new public safety 800MHz frequencies were discussed revealed deep divisions between manufacturers and users.

With respect to APCO's growth, it is spurred by:

- frequency coordination responsibilities.
- education and training programs.
- support of local chapters.

Growth has brought bigger budgets. APCO also has found it needs more staff members and consolidated office space for its New Smyrna Beach, FL, headquarters and frequency coordination activities.

Capital expenditures

Outgoing president Alan J. Lannier of the Washington, DC, Metropolitan Police Department said \$3.5 million would be spent over the next 20 years—\$2.5 million to acquire data processing and automated frequency coordination service (AFCS) capability; \$1 million to construct a headquarters building.

Frequency coordination currently is handled under a contract with CET Inc., Denver. For its headquarters, the association leases space in several New Smyrna Beach locations.

Lannier said acquisition of CET was being negotiated at the time of the con-



Gary David Gray: 'The FCC has allowed us to shape and determine our own future.'

ference. APCO executive director Robert E. Tall said the CET acquisition was uncertain—for one thing, a purchase price had not been agreed upon.

Other possibilities for acquiring frequency coordination capability were the purchase of software and other technology from the National Association of Business and Educational Radio (NABER) or Spectrum Management Services, a subsidiary of the Special Industrial Radio Service Association.

As for money to be spent on headquarters construction, APCO will spend \$50,000 each year for five years on the project. The remainder of the estimated \$1 million construction cost is to be raised through donations.

Gray is new president

Members also heard from the new APCO president for 1988-1989, Gary David Gray of Orange County Communications, Orange, CA. He said a major goal for APCO is the rapid completion and FCC approval of regional plans under the National Public Safety Communications Plan and licensing of the 821MHz to 824MHz/866MHz to



Sam Gargaro: 'Local frequency coordinators are improving monthly.'

869MHz public safety frequencies.

"For the first time the FCC has allowed us to shape and determine our own future," Gray said. "It is vitally important that APCO take all the steps necessary to finish the project before we lose access to these resources."

Gray also said the organization's executive committee directed elected officers to prepare a one-year plan to accomplish the following objectives during fiscal year 1988-1989:

- Arrange for suitable headquarters facilities, including construction of a new building.
- Activate the APCO Institute to provide training and education for telecommunications operators.
- Activate automated frequency coordination service.
- Meet the FCC-mandated 20-day deadline for completing the processing of frequency coordination requests.
- Hire a replacement for the frequency coordination director, Charles F. English, who has announced his intention to retire.
- Hire a deputy executive director to assist Tall and to replace Tall upon his

retirement.

- Establish a retirement plan and benefits package for APCO employees.

- Set criteria as qualifications for executive committee members and officers.

- Assist regional planning groups operating under the auspices of the National Public Safety Planning Advisory Committee to complete their plans for the use of 6MHz of spectrum in the 800MHz band, spectrum the FCC allocated in 1986 for public safety use.

- Update the association's manuals.
- Revise the association's committee structure.

- Further strengthen the headquarters office so it can lend more support to the annual and regional conferences.

- Initiate an education program directed to federal and state legislators.

- Begin a program to help volunteer leaders at the chapter level to improve their skills.

- Lend more support to local chapters.

- Initiate a grants and endowments program.

- Centralize accounting and billing functions.

- Require better management reporting, making use of automation capabilities expected to be activated during the year.

- Conduct a drive to boost membership from 6,000 to 7,500, in part by giving more attention to services that can be provided through chapters.

President-elect George W. Murray of the Georgia Department of Public Safety, Atlanta, reported that the APCO Institute will begin operations in October. Murray is chairman of the institute's board of directors.

First vice president Sam Gargaro of the Minnesota Department of Transportation, St. Paul, MN, told members that the massive backlog of frequency coordination requests had been cleared from the headquarters office. Gargaro chairs the automated frequency coordination services committee.

He said that, at one time, a backlog of unopened mail awaited processing in New Smyrna Beach. By the time of the annual conference, all requests were being processed by headquarters staff within 20 days. Processing at the local level extends processing time beyond the

FCC requirement that 90% of the requests be processed within 20 days, he explained. "But local frequency coordinators are improving monthly," Gargaro said.

Executive director Tall told members the association's income rose from \$1.1 million in 1987 to \$1.9 million in 1988, an increase of 36%. He said the 1988-1989 budget is \$2.371 million.

Tall is responsible for raising building fund monies through donations and other means. Frequency coordination processing fees will not be spent on the building, except as an allocation of rent. The frequency coordination operation is expected to be managed separately from other APCO functions by the time it is moved to the new headquarters building.

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Leiter and Company, a management consulting business in Kansas City, MO, to help to develop a long-range plan for APCO and to study its headquarters operation.

The plan and study results were summarized by Lawrence-Leiter representative David Domsch at an open session. According to the study, challenges facing APCO stem from explosive growth in frequency coordination, publishing, convention, education, training and chapter support activities. "Management and administrative systems have not always kept up with this growth," Domsch said.

The headquarters staff was found to be overworked and underpaid. Quarters are cramped and separated between two locations in New Smyrna Beach. Having the database for frequency coordination in Denver further complicates the situation. A single, consolidated headquarters building is a top priority.

"Frequency coordination applicants must be treated as customers because now they pay for a service that used to

be free," Domsch said. "When APCO offered frequency coordination for free, it had the right to define the service. Now, it must respond to market demands."

The consultant recommends substantial changes to the frequency coordination paper flow and fee schedule, and



David Domsch: 'Management and administrative systems have not always kept up with [APCO's] growth.'

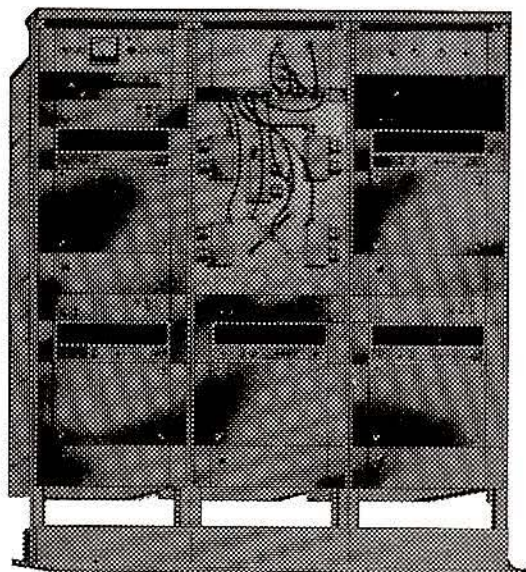
the hiring of a strong administrator for what will become a separately incorporated frequency coordination organization.

In many areas of APCO's headquarters operation, the consultant recommends the automation or computerization of many tasks currently performed by hand, including data processing, publishing, frequency coordination, and folding and enclosing printed materials to be mailed.

The plan also recommends pay increases, a benefits package and a retirement plan for employees, additional staffing and the separation of responsibilities for convention management and publishing.

"New responsibilities and opportunities have been grasped, and APCO is operating on a scale more than eight times larger than it was in 1983," the study reads. "Procedures and methods that work on a smaller scale frequently are not up to the demands of a larger business."

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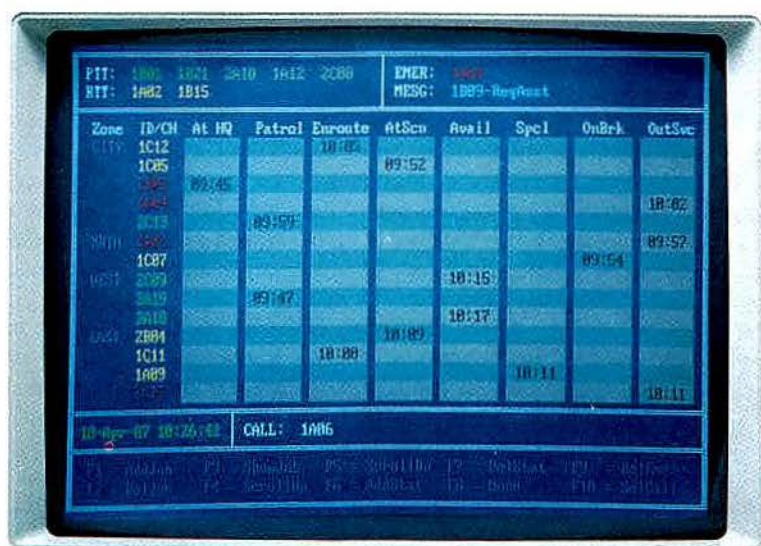
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Procurements advance Glenayre to full wireless communications supplier

Glenayre Electronics acquired 58% of the outstanding shares of common stock in Kustom Electronics, Lenexa, KS, for \$7.3 million on June 6. The acquisition is the fifth in a string of land mobile companies bought by the Vancouver, British Columbia, company. The purchases define a pattern that may lead Glenayre to become a full wireless communications supplier.

Among Glenayre's acquisitions are manufacturing companies and radio common carriers (RCCs):

- **Mobile Network Engineering**—Purchase terms not disclosed. M-Net was a division of another company.

- **Millman's**—Purchase terms involved an exchange of stock and cash. Millman's is an RCC in Edmonton, Alberta.

- **Kustom Electronics**—Purchase price \$7.3 million for a 58% interest. Kustom makes mobile data terminals and police radar equipment for speed limit enforcement.

- **Ferritronics**—Purchase price for 35,000 shares was undisclosed. Ferritronics makes signaling equipment in Markham, Ontario. Glenayre will consolidate Ferritronics with the Glenayre facility in Markham.

- **Communications SR**—Purchase terms involved cash, but otherwise were not disclosed. The company is an RCC in Chicoutini, Quebec.

Given Glenayre's extensive purchasing power, one might ask where it obtains its capital financing. The answer is not available from its chairman, L. Claude Simmonds: "We've received appropriate funding for financing but we do not want to disclose the source at this time," said Simmonds, who also served as acting president until the appointment of John J. Hurley to that post in June. Simmonds also is chairman and president of A.C. Simmonds & Sons in Canada and was named chairman and chief executive of Kustom Electronics in June.

Glenayre's marketing strategy is: "To establish, using Glenayre as a foundation, a significant entity in the wireless communications industry based in North America and serve the communications industry worldwide," Simmonds said.

To further this goal, more acquisitions are most likely in the works for Glenayre. But the company is a public entity, so its principals are barred by law from revealing information about pending acquisitions.

Glenayre's primary objective is not to seek out communications network operations, "but if circumstances make it desirable as they did in two Canadian cities, yes," Simmonds said. Glenayre purchased the two Canadian RCCs because "we did not want good RCCs to fall into competitive hands. It became a matter of competition."

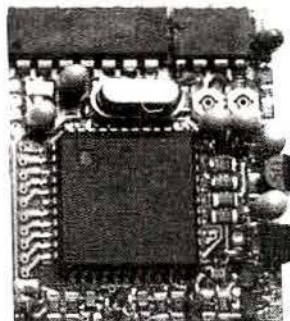
Until July, Glenayre retained a 12% stake in Mobile Data International (MDI) of Richmond, British Columbia,

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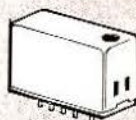
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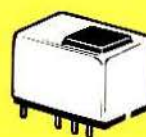
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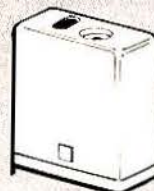
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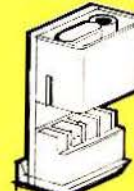
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News

another mobile data terminal manufacturer. Motorola, the Schaumburg, IL, communications equipment and semiconductor manufacturer, purchased an estimated 91% interest in MDI, including Glenayre's holdings, for \$13.50 (Canadian) per share. "The price on the shares offered by Motorola is not in the best interest of stockholders," said Simmonds. Glenayre had sought, unsuccessfully, to block the Motorola bid, or at least to win a higher price.

"The combination of MDI and Motorola makes it a significant competitor" in the mobile data terminal market, Simmonds said. But he expects

Glenayre to grow in the communications business and in the mobile data terminal market particularly, despite the MDI buyout.

"M-Net (Mobile Network Engineering) fits nicely into the MDT area," Simmonds said.

Some of Glenayre's acquisitions in land mobile are strong in the public safety radio communications market, but the company is not necessarily targeting this market segment. "Any market we're in, we like to be a strong force. Kustom is strong in public safety, and we see good synergy there," Simmonds said.

Radio Club names *Fellows*, lists 1988 award winners

The Radio Club of America's board of directors elevated 35 members to the grade of *Fellow* at its June 17 meeting. The new *Fellows* are:

Minnie M. Adams, Houston, chairman of the National Association of Business and Educational Radio.

Dr. Hugh G.J. Aitken, Amherst, MA.

Don Bishop, Merriam, KS, editorial director of *Mobile Radio Technology* magazine.

John E. Brennan, Old Tappan, NJ, member of Cellular Telecommunications Industry Association board of directors.

Capt. George K. Burton (retired), Red Bluff, CA.

Connie Conte, Rutherford, NJ, Radio Club of America executive committee member.

Robert I. Elms, Budd Lake, NJ.

Dr. Jacqueline Ericksen, Albuquerque, NM, vice president of All-Comm.

Earl H. Flath Jr., P.E., Dallas.

Lloyd A. French, Sacramento, CA.

John R. Galanti, Basking Ridge, NJ, vice president of Bell Atlantic.

Scott J. Goldman, Los Angeles, owner of The Goldman Group.

George D. Gaul, Jersey City, NJ, chairman of the IEEE Vehicular Technology Society New York chapter.

Arthur L. Greenburg, Wading River, NY.

Homer Harris, Aguanga, CA.

Ralph Haller, Merrifield, VA, chief of the FCC's private radio bureau.

Norman D. Hawkins, Pickering, Ontario, president of the Radio Club's Canadian section.

Gerald M. Howard, Dallas.

Jay R. Huckabee, Snyder, TX.

William O. Hunt, Dallas, chairman of Alliance Telecommunications.

Frank H. Jarvis, (retired) Longboat Key, FL.

Antionette Kaiser, Buffalo, NY, president of Sti-Co Industries.

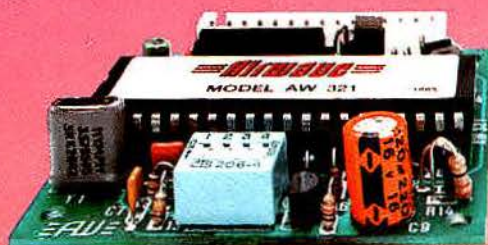
John A. Linton Jr., Uniontown, OH.

Ake L. Lundqvist, Stockholm, Sweden, president of Ericsson Systems.

Joseph F. Marshall, Hyattsville, MD.

AIRWAVE

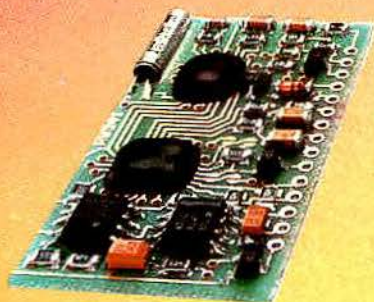
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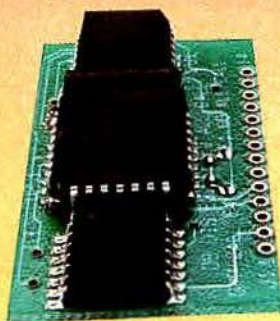
UNIVERSAL DECODER



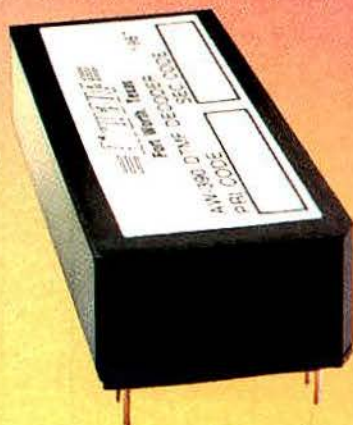
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J. William Miller, Fairfax Station, VA.

Harry J. Mills, Hendersonville, NC.

Clive H.K. Moffat, Cambridge, England, manager of Philips Radio Communications Systems.

Anthony Natole, Malba, NY, partner in Amoscato.

John Sawvel Jr., Cuyahoga Falls, OH.

Harry L. Schmidt, Scarborough, Ontario.

Dr. Herschel Shostek, Silver Spring, MD.

Ethel M. Smith, McLean, VA.

Gene F. Smith, East Brunswick, NJ.

George W. Weimer, Highland Village, TX, partner in Raymond C. Trott Consulting Engineers.

Award winners are:

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Dr. Ralph Muchow—*Ralph Batcher Memorial Award*

Francis T. Cassidy—*Henri Busignies Memorial*

Fred M. Link—*Lee deForest Award*

William B. Kelly—*Allen B. DuMont Citation*

F. Stuart Meyer—*Fred M. Link Mobile Radio Award*

Francis H. Shepard Jr.—*Pioneer Citation*

David Talley—*Presidents Award*

Mal Gurian—*Sarnoff Citation*

Jerry S. Stover—*Special Services Award*

The Radio Club will hold its annual meeting and awards banquet on Nov. 18 at the New York Athletic Club in New York. William O. Hunt, chairman of Alliance Telecommunications, Dallas, will deliver the banquet address, "From Riding Waves to Making Waves: The Need for Leadership in Mobile Communications."

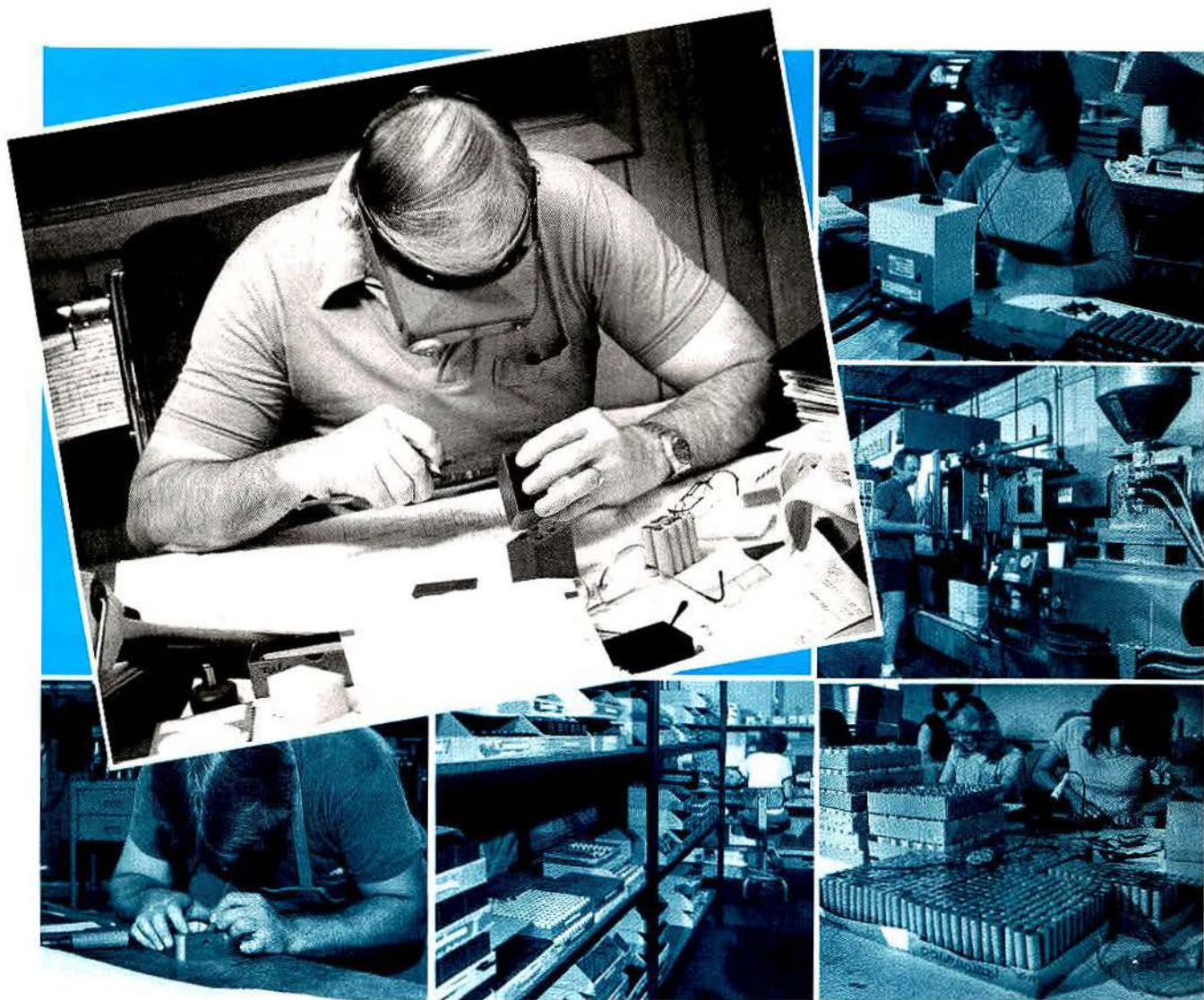
2,000 more may become Motorola Radius resellers

By mid-June, inquiries from potential resellers of Motorola's low-tier two-way radio product line far outstripped the Radius division's ability to respond. Division vice president Tony Lane said that he expected everyone who has inquired about reselling the products would have received a personal response by Aug. 1, if not earlier. "Inquiries from two-way radio dealers are coming over the transom, by phone, through the mail and via referrals," Lane said.

Lane joined Motorola as an entry-level sales representative. Prior to being named the division vice president, he served as the division's business manager.

In April, the division had five employees making personal visits to prospects who wanted to become resellers. "That number has increased dramatically," Lane indicated.

The Radius line was developed within the company's direct distribution arm and was introduced in 1987. The Radius Products division was formed in December 1987 to offer the product via indirect sales. "The division broke the product out in December 1987," Lane said. "Distribution really began the fourth week of January through several channels simultaneously: catalog houses, MSSs and competitive dealers." Since then, some catalog houses have



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been named resellers, and a number of two-way radio dealers have joined the program.

Motorola employees interviewed MSS operators and dealers during 1986 and 1987. The purpose was to develop marketing information. "We did not use that information in selecting resellers," Lane said. "To select resellers, each Radius sales representative performs an analysis, territory by territory, of which prospective resellers are available. Each representative then uses various resources to evaluate the kind of reputation each prospect has."

Reputation ranks high on the list of reseller qualifications. The Radius division managers want resellers who have proven their dedication to customer satisfaction. Inquiries are made in a prospective reseller's community to "be sure the prospective reseller has as its first priority a satisfied customer." Other factors considered are the reseller's length of time in business, the experience of its managers, and how actively and aggressively it pursues the two-way

radio market. "The business profile helps us in making a credit decision on a prospective reseller," Lane said.

Non-scientific, random surveys conducted by *MRT* seem to indicate that more MSS operators than dealers have become resellers. "We make no conscious effort to have more MSS operators than dealers," Lane said. "If it winds up more MSS operators, so be it. The deciding factor is reputation."

Entry requirements are "fairly small," according to Lane. Resellers are asked to commit to a minimum order of products to enter the program. "The number of units they keep on the shelf for immediate delivery is in proportion to how well they want to serve their customers," Lane explained.

The resale program offers product training and literature, including specification sheets and color brochures. Resellers are given an outline for a promotional plan. Promotions involve clip art, yellow pages telephone directory advertising, newspaper advertising, envelope stuffers and even a

booth for use at local, regional and national trade shows.

The division chose not to offer a coop advertising program. "Instead, we initiated a promotional accrual program," Lane said. "We accrue 3% of the net from every invoice. Resellers can draw from the accrued balance without having to match the funds. They pay the promotional expense, submit an invoice to us for that expense, and we send them a check to reimburse them up to the amount accrued in their account."

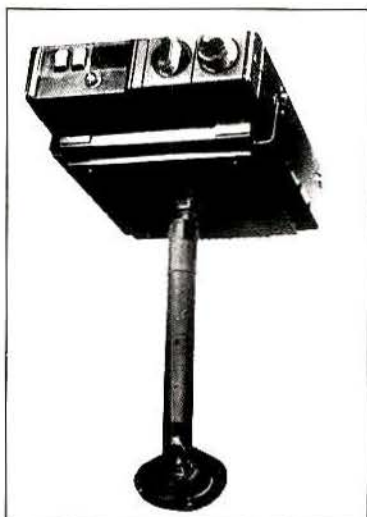
Lane and his sales representatives have found themselves traveling to every corner of the country to speak with prospective resellers. "We continue to press forward daily into the marketplace to develop resellers," Lane said.

The current line of portables, mobiles and repeaters could be augmented with other products. Lane indicated that the Radius division is evaluating new product offerings to provide the reseller. Some of them may be included in the line if market studies show that the additions are warranted.

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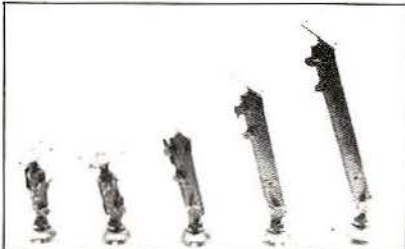


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Vehicular Technology Conference attracts 370

Activities at the 38th Institute of Electrical and Electronics Engineers (IEEE) Vehicular Technology Conference held June 15-17 in Philadelphia reflected mobile communications' rapid growth. Conference delegates numbered far in excess of last year's attendance, 370 vs. 264; the number of papers presented increased 21%, 121 vs. 100; nearly twice as many foreign countries were represented, 20 vs. 11; and the demand for conference records (bound volumes of technical papers) exceeded the supply.

Conference chairman John Galanti, vice president of engineering at Bell Atlantic Mobile Systems, Basking Ridge, NJ, reported to the Vehicular Technology Society board of directors that the number of papers concerning cellular mobile telephone topics and the number of delegates with a primary interest in cellular made the 1988 meeting a cellular-related conference.

Next year's conference will be held in San Francisco, April 30 through May 2 at the Sir Francis Drake Hotel.

Motorola to supply Los Angeles simulcast system

In order to alleviate radio communications congestion for the Los Angeles Fire Department, the city has awarded Motorola, Schaumburg, IL, an \$18 million contract to supply a simulcast radio communications system. Implementation is planned for December. Digital multiplex modems will distribute voice and data signals to 800MHz repeater sites throughout the city. The modems digitize voice-frequency signals so they can be carried along with signals from other modems through time division multiplex (TDM). The signals then will be applied to a digital microwave system. Other Motorola components in the system include 900 mobile radios, 1,400 portables, three microwave radiolinks and 128 base stations at nine sites.

Centel acquires United TeleSpectrum

After a \$763 million agreement, Centel, Chicago, has acquired the 16-state mobile communications and paging operations of United TeleSpectrum, Kansas City, MO. United TeleSpectrum is the majority owner in 21 markets and the minority investor in 17 markets. It has 29 paging systems in seven states. With the acquisition, Centel has control of 40 markets, mainly in the Southeast. In addition to the purchase price, Centel will repay a \$9.5 million debt that United TeleSpectrum owes to parent United Telecommunications, Fairway, KS.

CUE Paging doubles market

CUE Paging, Irvine, CA, reports that its markets have doubled since it was acquired by Nokia-Mobira, Basking Ridge, NJ, on April 22, 1987. Since June 1988, CUE has had an average of 2,000 square miles of coverage in more than 130 cities.

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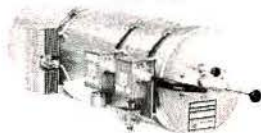
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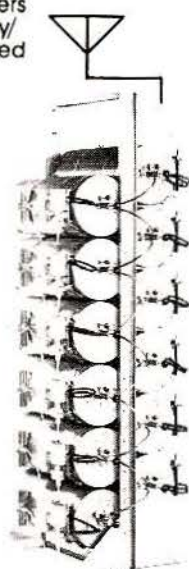
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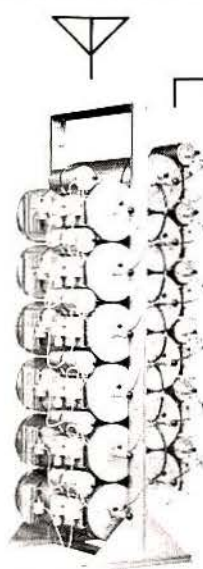
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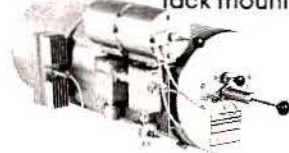


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"Commonwealth Saved Our Bacon"

Mary Kelley
Springfield Radio Communications
Springfield, Oregon

In the wee hours of a Saturday morning last January, Bob and Mary Kelley learned that their 32-year-old business was in flames. Burglars, trying to cover their tracks, set several fires inside the Kelley's radio-repair business, Springfield Radio Communications, Springfield, Oregon.

Despite the quick response of fire

fighters, the Kelleys arrived on the scene to find a mess—melted puddles of plastic, scorched electronics parts and the interior of the building totally blackened.

Remarkably, though, through the support of employees and friends, Springfield Radio Communications opened for limited business Monday.

But in spite of their best efforts they could not resume service for their mobile radio and pager customers. Their Commonwealth paging terminal simply wouldn't come back to life. The smoke and heat had done too much damage.

"We got tremendous technical support from Commonwealth, but we couldn't get

it working," Mary recalls. The only solution was a new unit.

Commonwealth immediately shipped the replacement unit.

"It was fantastic how they responded. We were back up by Thursday," Mary says, noting that while they lost a few of their customers they managed to keep the lion's share. "Commonwealth really saved our bacon. Without their help we'd have been in a real mess."

The smoke has long since cleared and Springfield Radio Communications is stronger than ever, thanks to a lot of friends—including Commonwealth.

For further information on how Commonwealth can help you when your business is in trouble or any other time, for that matter—call our toll-free number (800) 633-8844. In Virginia call (804) 798-9128. Or write Commonwealth Communications Industries, Ltd., 602 Lickinghole Road, P.O. Box 312, Ashland, Vir. 23005

Arson blamed in blaze at local business

By GREGG BULL
News Staff Writer

Three men were taken into custody after a fire broke out at a local business, the Springfield News reported on Thursday.

Bob and Mary Kelley, owners of Springfield Radio Communications, expect to have their business up and running again by the end of the week.

The fire broke out at the Kelley's radio-repair business, Springfield Radio Communications, Springfield, Oregon.

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Technicians to renew or upgrade 'grandfather' certificates

It soon will be time for those who hold National Association of Business and Educational Radio (NABER) two-way radio technician certificates granted under the "grandfather" program to renew their certificates.

NABER has certified more than 33,000 technicians since the program began in 1984. More than 30,000 hold "grandfather" certificates. NABER began sending renewal information to the "grandfather" certificate holders in September, and the mailings are continuing into October.

No one is required to take the certification exam to renew the certificate. Technicians may choose to:

- submit an application to renew the "grandfather" certificate.
- submit a renewal application and evidence of continuing education to receive a new certificate reflecting the technician's efforts to keep abreast of technical advances.

- take the test and receive a new certificate reflecting certification by examination.

Recertification fees

☐ **\$17**—The 'Early bird' fee is \$17 for those who recertify by Dec. 31, 1988, without testing.

☐ **\$22**—For recertification without testing after Dec. 31, 1988, the fee is \$22.

☐ **\$40**—For recertification via testing, the fee is \$40.

Renewal applications need not be accompanied by the original certificate or a photocopy of it.

Applications are available from the National Association of Business and Educational Radio's technician services office at 800-759-0300.

Association of Communications Technicians (ACT) members are about to receive their copies of the membership directory. The directory reflects ACT's steady growth—it lists more than 2,000 names. Some technicians have said they are especially eager to have the directory because it will help them to identify one another to form business affiliations, technical assistance groups and other networks.

The directory is one of several benefits offered by ACT, a NABER membership section. ACT members qualify for discounted prices for the *NABER Two-Way Radio Technician Certification Handbook and Rules and Regulations, Part 90*.

The handbook offers suggestions and tips for taking NABER's certification exam. Each exam section is outlined to reduce the amount of time that might otherwise be spent in unfocused study. The handbook explains strategies for

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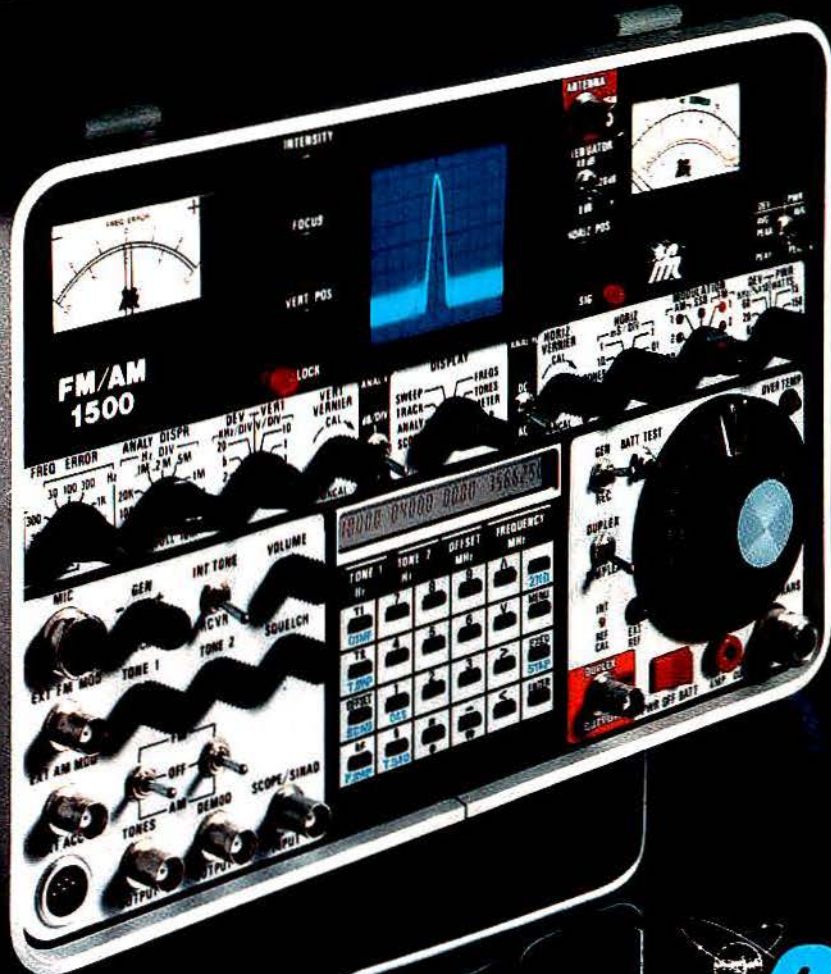
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
ACT update

taking the exam that help to improve test scores.

A sample exam with 150 questions includes 50 new questions that reflect recent advances in mobile communications technology. The handbook's study reference section has an expanded list of books recommended by industry consultants to help certification candidates prepare for the exam.

All ACT members also receive 10 issues per year of NABER's magazine, *Business Radio*, and a subscription to *TechTalk*, a newsletter written specifically for communications technicians.

Senior members of ACT receive a quarterly supplement, *TechTalk Plus*, which discusses technical subjects in depth. ACT members who hold NABER technician certificates are elevated to the grade of senior member. They receive a cloth patch to wear; the patch identifies the wearer as a NABER-certified technician.

Information about ACT and the technician certification program is available from NABER at 800-759-0300. 

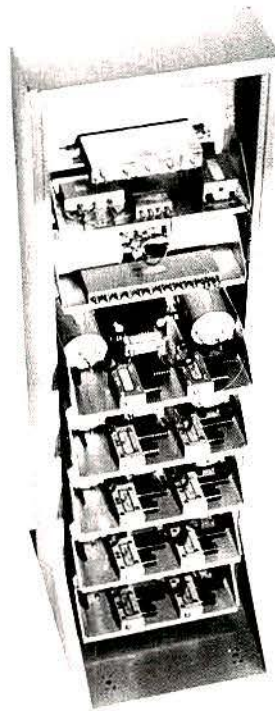


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MOTOROLA

Public safety wrestles with trunking standard

Demand for a public safety trunked radio communications system standard continues, despite a federal advisory committee's report that does not recommend such a standard.

Open Architecture for Public Safety Radio (OARPS) spearheads the drive for a standard. Boulder, CO, communications consultant Gary A. Hampton founded OARPS after the National Public Safety Planning Advisory Committee (NPSPAC) submitted its report to the FCC in April 1987.

Some question the source of OARPS operating funds. According to Hampton, prior to Aug. 2, 1988, OARPS was funded by:

- General Electric—\$20,000.
- Philips—\$10,000.
- Celltronics—\$3,000.
- Frederick G. Griffin, P.C.—\$500.
- Don Goodwin, LMR Industries—\$50.

On Aug. 2, OARPS decided to withhold information about contribu-

tions made thereafter.

The FCC has issued a notice of inquiry into whether a trunking standard should be required. William Torak, deputy chief of the spectrum engineer-



Wooldridge: 'Motorola supports interoperability. We do not support standardization.'

ing division in the FCC's office of engineering and technology, said the question of when a standard might result from the proceeding is unanswerable. "If there is total disagreement in the industry and among the users, I cannot see how you would expect the commission to dictate a solution."

The inquiry will be terminated in a matter of months, he predicted. But if it is followed by a proposed rulemaking to establish a standard, the outcome is uncertain. Only if the commission declines to pursue the matter after the inquiry would the question be resolved soon.

Panel members expressed themselves about a trunking standard during discussions at the Associated Public-Safety Communications Officers (APCO) 54th Annual National Convention held Aug. 8-12 in Little Rock, AR.

• **Motorola**—David Wooldridge, vice president and operations manager, state and local government division:

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Seated L to R — Alice Clary, Carroll Hollingsworth, Debbie Bruner. Standing L to R — Kayla Pursley, JT Summerlin, LaDonna Johnson. Not Pictured — Jim Oliver.

WE'RE BACK

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Regulating technology

"Motorola supports interoperability. We do not support standardization."

"The measure of whether standardization is right or not is whether it is good for the user. We believe that it is not good enough for the user so we, at this present time, do not support standardization."

Responding to a question as to whether suppliers would agree to license other vendors, Wooldridge responded,

"If you make a commitment to a customer at this level of complexity, system integrity, system dependability and ownership by the supplier are extremely important."

"As a result, we should be a total system supplier. As I said last year, we did not believe in licensing then and we do not believe in licensing now."

"Standardization will not satisfy the important needs of interoperability. The

real issue is concern for second-sourcing and competitive pricing," Wooldridge said.

• **General Electric**—Jeffrey Childress, GE's program manager for public safety trunking and Voiceguard: "It is imperative that the users dictate the level of interoperability that is acceptable and the preferred method for achieving that level."

"Interoperability creates flexibility and competition. If these truly are user issues, you must do four things:

"First, you must define what interoperability means to you, not us."

"Second, you must consider all your alternatives."

"Third, you must weigh the benefits and costs of each of those alternatives."

"Fourth, you have to make your position known."

Childress continued, "If you users really desire a standard—and obviously the manufacturers and the FCC do not desire a standard—it is an alternative, nevertheless."

"The benefits include:

"(1) 100% compatibility, just like cellular."

"(2) competition."

"The costs incurred include:

"(1) a delay in channel licensing."

"(2) the abandoning of existing systems."

"(3) the retardation of trunking system development."

Childress said that, given the benefits in light of the costs, a trunking standard is being considered only because an alternative solution is not available.

He said another alternative is to use the mutual aid channels as defined by NPSPAC. "This approach was initially accepted because of the pressing need for the frequencies. It is an inexpensive solution, consistent with current methods of patching conventional channels into trunked systems."

"The benefits include:

"(1) It is available today."

"(2) Its operation is consistent with current limits of conventional and trunked system operation."

"The costs incurred in the long run:

"(1) It is not frequency-efficient."

"(2) It is a less easily managed resource."

"(3) If you are not patching, it forces the user to make channel selections he normally does not make on a trunked



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Regulating technology

system.

"(4) It subjects the trunked user to a different mode of operation, particularly during a stressful emergency situation when his focus should be on his task, not on his radio.

"(5) If you are patching, access times can be increased, sometimes by a factor as great as 2.

The GE program manager for public safety trunking said the latest alternative to be suggested is a translator or

gateway. He said the process is straightforward and is not new. "It is an elegant way of saying, 'patch.' "

"(1) The benefits include intersystem communication, but the costs include extra hardware.

"(2) It lengthens access time by as much as a factor of 2 if you are going from one trunked system to another.

"(3) It forces dispatcher involvement, or else frequency inefficiency.

"(4) It does not address the issue of one manufacturer's mobile roaming into another manufacturer's system and maintaining trunked operation.

"(5) It can distract the trunked user when his focus should be on his task and not his radio.

"(6) It does not promote competition following initial system procurement."

Fabrication of a multimode radio is another solution. It involves placing multiple vendor protocols into a single radio. This solution can address all the issues: interoperability, performance, roaming and competition. The benefits include:

(1) 100% interoperability.
(2) roaming capability between systems.

(3) flexibility in system procurement. Users can purchase different systems as they grow, taking advantage of various vendors' perceived differences and strengths.

(4) increased competition during follow-on procurement stages.

(5) incentives for continued future enhancements among the manufacturers.

(6) no degradation in system access time.

(7) no delay in channel licensing.

Costs include approximately \$10 per radio in additional component costs to the manufacturers, according to the GE program manager.

"Those are the options." Childress said. "As you discuss standardization and interoperability—interoperability specifically with its operational and procurement-related advantages—remember that standardization encourages a competitive environment, one typically not in the manufacturers' best interest." He continued, "Our economic system creates the conflict; it is not the fault of a particular individual or corporation. But that does not mean you should not be aware of the conflict when you listen to technical solutions proposed by manufacturers. Maintaining the proprietary nature of their systems meets their objectives and not necessarily yours.

"Manufacturers are struggling with a conflict of interest: theirs and yours.

"There are four alternatives on the table:

"(1) standardization.
"(2) the existing mutual aid channels.

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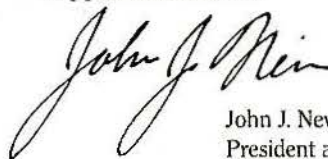
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Regulating technology

"(3) translators or gateways.

"(4) multimode radios.

"Or even some combination thereof,"

Childress said. The panel session specifically devoted to a trunking standard did not include panelists from Philips Radio Communications Systems or E. F. Johnson. But their representatives spoke about the subject in another session.

• **E. F. Johnson**—Bob Brandel, vice president: "It is our belief from a business standpoint that, in the long run, standardization would be in the best interest of the total industry. It would be in the best interest of the end-user, the manufacturers and the taxpayers.

"From a marketing standpoint, it is a user issue more than a manufacturer issue. You won't find a manufacturer here who would say, 'if you elect standardization, we won't participate.' Anyone who wants to be an active participant in the 800MHz trunking industry will elect to do whatever the user community, combined with the

regulators, elects to do.

"We are willing to do whatever the user community ends up doing. If the user community opens itself to standardization, we will support it. If that is a licensing of someone else's system, we will support it. If it is the licensing of

our own system, we will support it.

"It is a user call, a market call, and not a manufacturers' call," Brandel said.

• **Philips**—Joe Gallelli, systems manager for the United States: "The user will decide. The issue is clear. Let's go on."



Brandel: "...standardization would be in the best interest of the total industry."

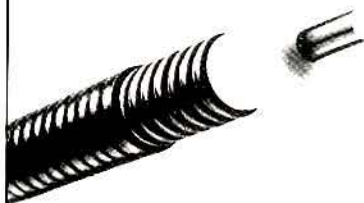
Officials laud radio plan, address trunking standards

The two top FCC private radio bureau officials spoke during a regulatory session at the Associated Public-Safety Communications Officers (APCO) 54th Annual Conference held Aug. 8-12 at Little Rock, AR. Bureau chief Ralph Haller said, "There is not enough spectrum for everyone. We at the commission need to know what the issues are, in your view. We need your help in evaluating competing demands."

He told the audience, "The people in this room represent the most noble course of all: safety of life and property. What could be more important than

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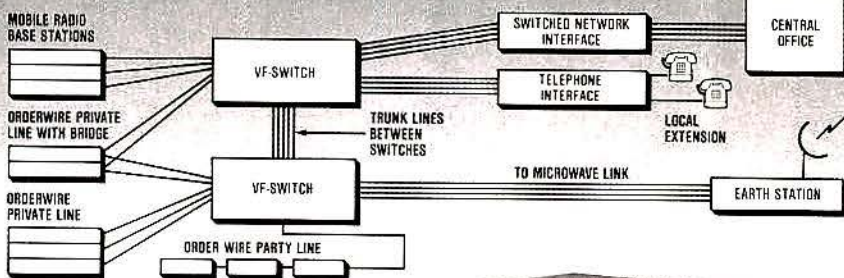
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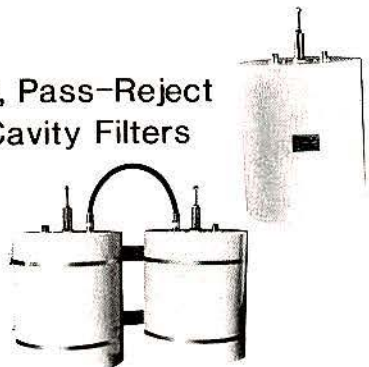
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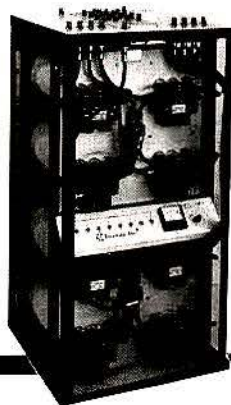
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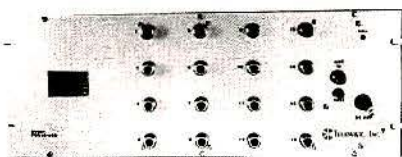
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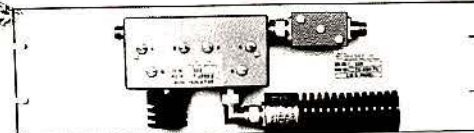
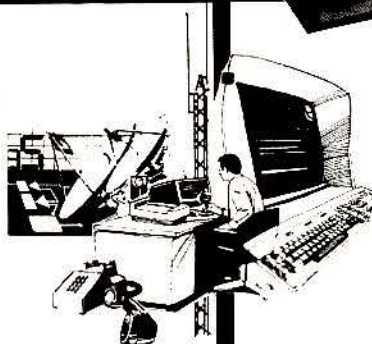
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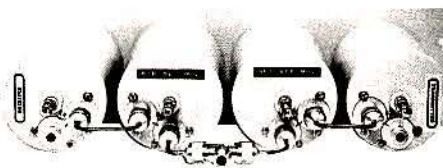
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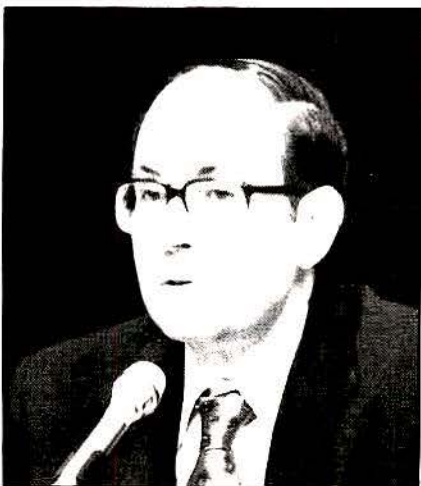
Regulating technology

that? Make sure everyone knows the importance of the work you do."

Haller said that land mobile radio is a "hidden industry" that supports other functions. He cited an example of police response to an emergency call, in which radio communications plays a vital role—but a role invisible to citizens. He said public safety agencies must accept the responsibility of informing the public, government agencies and legislators of their communications support requirements.

Planning committees

Haller praised the efforts of regional planning committees of the National Public Safety Planning Advisory Com-



Haller: 'You have the opportunity to make history.'

mittee, saying, "Your efforts in the regional process can lead to the most efficient and the most effective spectrum management tool that we have ever had. Demands meet the resources in a town meeting atmosphere. You have the opportunity to participate in history. You have the opportunity to make history. You have the opportunity to make this experiment work."

Later during the session, three regional planning committee representatives presented Haller with the first regional plans to be completed. The representatives were Charlie Bowles from Dallas, Carroll White from the Port Authority of New York and New Jersey and Robert Ferrell from the Florida State Department of Telecommunications.

The bureau's deputy chief, Beverly Baker, said the FCC notice of inquiry regarding public safety trunking stan-

dards would leave little time for response—in fact, the response cycle probably will have closed by October. The notice was expected to provide a 30-day comment period, a 15-day reply comment period and no provision for an extension of those periods.

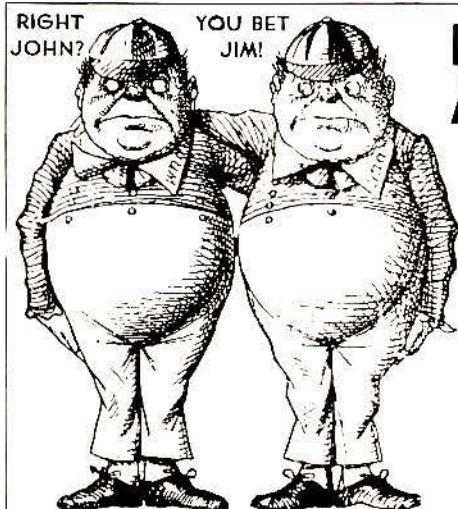


Baker: 'How long will it take to establish a [trunking] standard?'

"The substantive issues," Baker said, "involve competition among equipment suppliers and the effect that trunking might have on the interoperability of systems."

She said that the practical issue involves timing: "How long will it take to establish a standard and how do you balance that length of time—any delay that that might cause—against the need for licensed spectrum?"

Baker noted that FCC commissioner James Quello is on record as opposing licensing until the commission has reviewed the comments submitted to the notice of inquiry. With only three commissioners in office out of five commission seats authorized by Congress, Quello is in a position to block licensing by withholding his vote. Without all three commissioners voting, the commission lacks a quorum.



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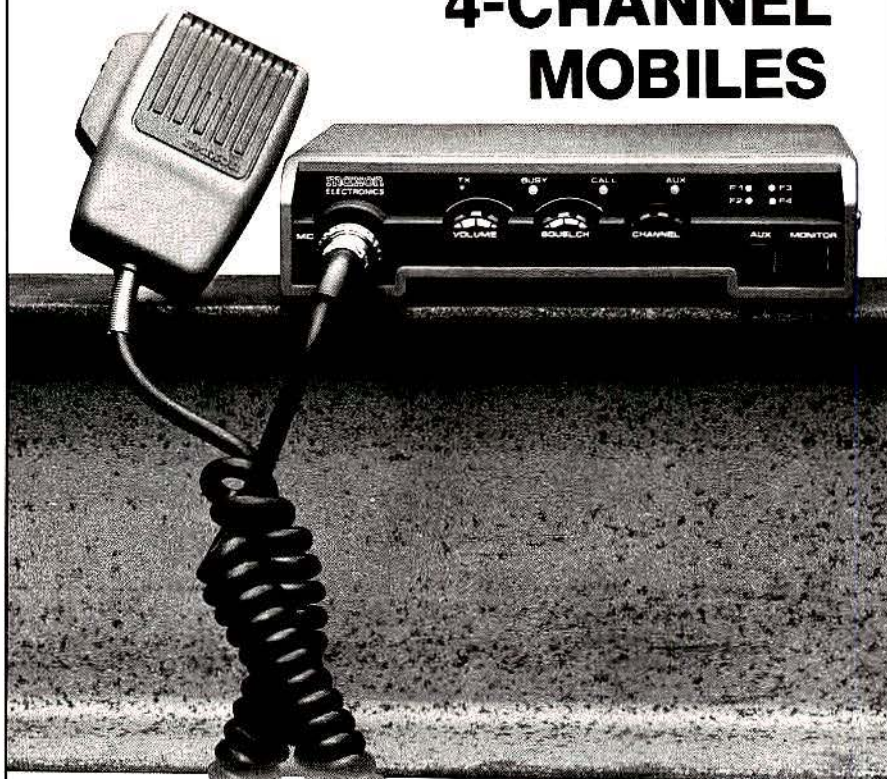
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The controls are easily accessible and feature bright LED indicators. And the face-plate, microphone and optional auxiliary speaker are made of durable, heat-resistant Noryl-190®.

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Regulating technology

National public safety plan: Commission upholds decision

Public safety users step closer to licenses for 6MHz of 800MHz spectrum as the FCC upheld its decision to accept the national public safety plan (NPSP) developed by a federal advisory committee.

The FCC's rulings:

- *General Electric*—The agency denied GE's request to mandate a trunking standard. Instead, the FCC initiated a *Notice of Inquiry*, asking for public comment on the subject of trunking standards.

- *Cellular Telecommunications Industry Association*—The FCC responded to CTIA's concerns about interference from public safety channel 830 to cellular channel 991. The commission asks public safety system operators planning to use channel 830 to cooperate with cellular system operators using channel 991 nearby.

- *International Municipal Signal Association and International Association of Fire Chiefs*—Responding to a petition from IMSA and IAFC, the FCC reaffirmed that all public safety and special emergency services in a given region would have to be fairly represented on regional planning committees.

The decision clears the way for FCC review and approval of regional public safety plans, but licenses will not be issued at least until the agency concludes its inquiry into trunking standards.

FCC asks for more comment on alternative type acceptance

The FCC has asked for more comment from the public regarding a proposed equipment testing and authorization procedure for land mobile transmitters, called alternative type acceptance (ATA).

The procedure is outlined in a rulemaking proceeding in Gen. Docket 171. Its goal is to encourage the most efficient introduction of new equipment and technology. The proposed rules would eliminate the need for lengthy rulemaking proceedings that presently

are required to establish new technical standards.

Also, the applicant would not be required to reveal technical details of proposed equipment. Confidentiality is seen as an important factor in obtaining venture capital to develop new technologies.

In response to concerns stated in comments previously filed, the FCC has proposed a different methodology for ATA testing and frequency coordination. Its previous methodology was based on standard receiver characteristics; now it proposes a methodology based

on transmitter characteristics. The methodology compares the characteristics of a transmitter or multiple co-located transmitters using new technology to the characteristics of a conventional FM land mobile transmitter.

"This modified procedure would eliminate the frequency coordination problems raised previously by the commenters," the agency's announcement reads. "Frequency coordination of ATA equipment will require no more effort than a conventional FM transmitter with equivalent transmitted power."

FCC divides 216MHz band three ways

Radio amateurs lose 2MHz to land mobile in an Aug. 4 FCC frequency allocation action that leaves maritime mobile services untouched and resolves certain sharing issues.

- *Maritime mobile*—Retains its 216MHz-to-220MHz allocation.

- *Land mobile*—Wins a 220MHz-to-222MHz allocation for narrowband technologies but shares the frequencies with government users. Service rules

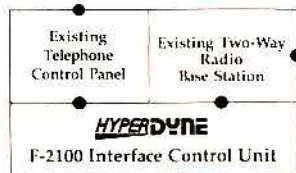
and issuance of licenses are one to two years away. That the new rules will provide for the use of amplitude modulated single-sideband (ACSSB) is possible, but not assured.

- *Amateur radio*—Loses 2MHz to land mobile but gains exclusivity in 222MHz-to-225MHz band, which it previously shared with government radiolocation (radar) services.



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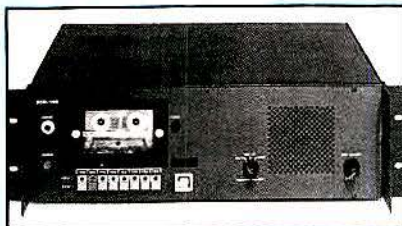
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Readers' choice

Of all the new products and services covered in the March issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact number on the Fast Fact Card found in the back of this issue and mail the card to us.

Recorder has 12-hour capacity on a C90 cassette



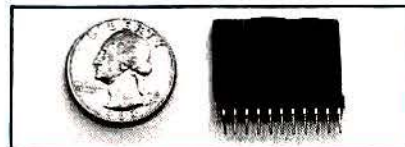
As much as 12 hours of recording time is possible with the DRC 100 Documentation Cassette Recorder

made by **Data Capture**, a division of Hathaway. The unit's dual speeds (1 7/8 and 15/32 inches per second) with automatic reverse make the unit suitable for voice logging and recording. Options include an external time-code generator and reader, security lockout, battery backup, telephone interface with a beeping tone, and a twin unit that boasts two transports.

Circle (318) on Fast Fact Card

Voice scrambler fits into small spaces

The VPU-7 voice scrambler measures only 1.1"L x 0.69"W x 0.18"H. The **Midian Electronics** unit has a wide dynamic range, an anti-falsing input filter and a six-pole output filter. The crystal-controlled single inversion process offers low distortion audio recovery.



Circle (317) on Fast Fact Card

THE BOMAR Power Line

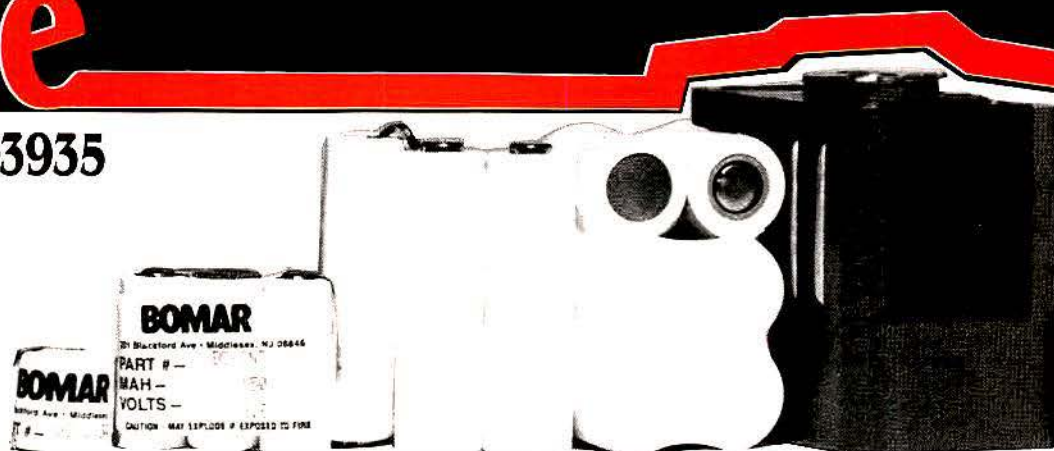
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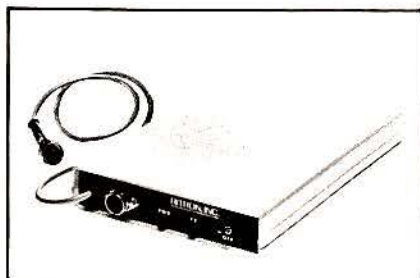
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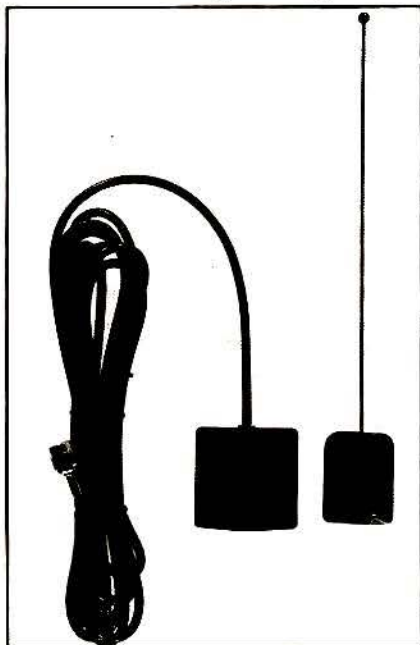
Mobile radio extender boosts portable transceiver range



The UHF version of **Ritron's** Mobex mobile radio extender gives hand-held transceivers the effective power and range of a mobile radio and retains the convenience and versatility of a portable unit. In most cases, the Mobex connects to the mobile radio with a simple plug-in connector at the mic jack.

Circle (319) on Fast Fact Card

Glass-mount antenna features a straight whip



The Apollo glass-mount antenna from **The Antenna Company** has a trim 10-inch straight whip and solid metal adjustable foot. It features computer chip exact tuning, balanced cable lengths and factory-attached TNC connector.

Circle (256) on Fast Fact Card

Synthesized hand-held offers 5W, 16 channels



The Regency Plus RSP 165 synthesized portable radio operates in VHF 148MHz to 162MHz range. The programmable radio from **Regency Electronics** offers 16 channels and has 5W RF output that is switchable to 1W. DTMF and scan are built in.

Circle (184) on Fast Fact Card

Radio design program calculates coverage, paths

The Pathfinder Plus radio system design software from **The Jack Daniel Company** allows the user to see what effect the change of a single characteristic in a radio system design would have, without entering additional information. The program calculates coverage, signal margins, tower height requirements, power levels, path gains and losses and distance. Information automatically is converted and displayed in decibels referenced to a milliwatt (dBm) and microvolts or watts, regardless of which type of data entry is made by the user. The software is available as a 5¼-inch disk for PC, XT and AT monochrome or color-compatible computers.

Circle (455) on Fast Fact Card

Mobile phone terminal allows customized service

The updated **Hark AMT-2** advanced mobile telephone terminal allows system owners to customize subscriber service on an individual basis. The unit contains features such as call forwarding, call notification and speed dialing.

Circle (479) on Fast Fact Card

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ModuLink System 1 is the first cost-effective mobile microphone/cordset system designed to reduce your inventory and improve your service efficiency. Now you can simply stock cordsets and a single line of microphones for all the radios you use and service.



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ModuLink microphones feature Top-Talk Sound Channels™ which end muffled voice input if the user grips the mic from the front.

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New products

Mobile radio is available with encryption option

The Spectra mobile radio from Motorola operates in VHF and UHF broadband. Securenet digital voice encryption is available with the mobile, and the radio can be ordered as a dash- or remote-mount unit. A unit identification and emergency signaling feature,



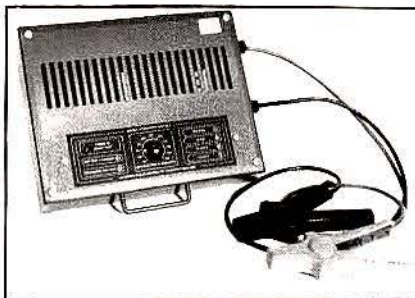
the MDC-1200, is standard. The mobile offers 50W VHF and 40W UHF output. It meets military specs for vibration, shock, rain, dust and salt fog. The Spectra comes in A5 and A7 packages.

In its A5 package, the unit has an alphanumeric display and 128 synthesized channels. It also has DTMF interconnect encode capability. In its A7 package, it comes with a call alert

decode feature for paging an individual mobile unit. The package also has DTMF interconnect and operator-selectable fast-lock channel scan monitor.

Circle (271) on Fast Fact Card

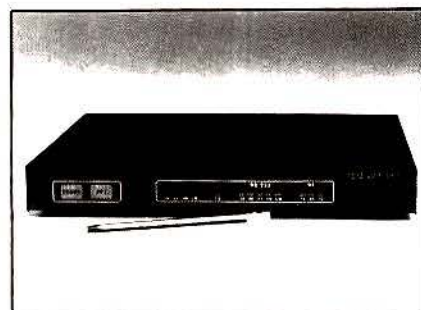
Test set is available for lead acid batteries



The Astratec model 42 automatic 12V lead acid battery test set from Adcour provides complete cycle in 40 seconds. Battery conditions are displayed by LEDs. The set is portable and accommodates batteries from 40Ah to 140Ah.

Circle (265) on Fast Fact Card

Datalink controllers add packet radio to systems



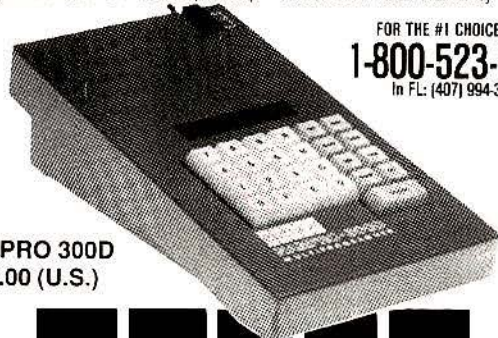
Modem datalink controllers (MDLCs) from Dataradio add packet radio to existing systems. The controllers are available for 1,200bps, 2,400bps, 4,800bps and 9,800bps, depending on existing base equipment or mobile equipment in service. The MDLCs operate from 12Vdc or 16Vac; a 110V external power pack is optional. A 6-bit parallel digital I/O port is standard on all units.

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SMR Trunking Mobiles.

Neutec's 800 MHz trunking mobile is designed to push profits to the bottom line of any trunking or conventional system. "Thru-the-mic" programming and a "no-tune" design, reduce the labor that is costly with many of its competitors.

Built For Long Life Reliability

The SM-1020T contains the latest in surface mount technology and hybrid module sophistication. Field tuning and aging problems are virtually eliminated due to minimized tuning components. Adding to this the radio's die-cast housing assures long-life reliability.

Flexible Cloning Options

Cloning may be accomplished with either a cloning cable between two radios, or with an optional handheld memory unit for cloning or re-programming. This transport unit can read or write data without radio removal from the vehicle. This feature alone saves valuable time and can help control system piracy. Neutec also offers non-cloning versions to meet individual customer needs.

LTR™ Trunking Compatibility

The SM-1020T is able to operate under full LTR™, or optional Americom compatibility on trunking systems with up to ten systems and ten group ID's. Conventional channels can also be programmed in any of the ten system positions; with optional CTCSS tone signaling.

Programming Simplicity

Programming of the radio is easily performed on any IBM PC™ or compatible computer with Neutec's intelligent software and "thru-the-mic" programming cable. The inexpensive software package offers easy instructions and automatic creation of customer files.



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New products

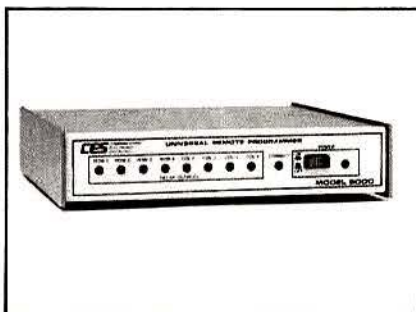
Power supplies feature automatic current limiting



Circle (462) on Fast Fact Card

Rack-mount power supplies from Newmar operate from 115Vac to 230Vac, 50Hz to 60Hz. They produce 12Vdc, 24Vdc and 48Vdc in outputs ranging from 18A to 70A. Protection features include automatic current limiting, thermal shutdown and overvoltage protection.

Remote programmer is made for LTR validator



The CES model 6000 remote LTR validator-programmer programs E. F. Johnson LTR RIC validator from any DTMF phone or equipped transmitter. It is supplied with a cable assembly to interface with the RIC validator and allows remote operation.

Circle (461) on Fast Fact Card

Random access phone system is suited for BETRS



The multichannel, rural radio telephone (MRRT) system from Telemobile suits basic exchange telecommunications radio service (BETRS) applications. With the MRRT, a single subscriber can be put on a single UHF channel to initiate service. Service later can be expanded to as many as eight random-access channels for as many as 96 subscribers. The system includes antennas, combiners, duplexers and the RF and trunking system.

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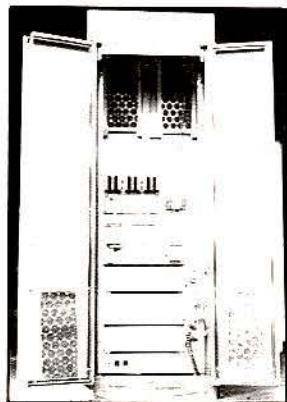
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42-50 MHz all solid
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Remote, Quiet Channel,
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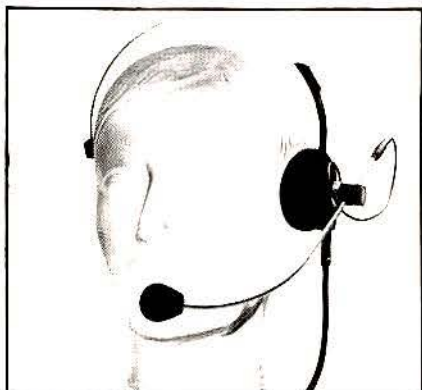
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Ask for Bill Ryan

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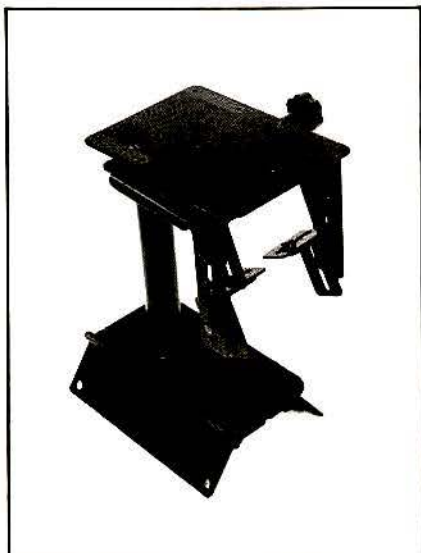
Lightweight headset has adjustable boom



The RHS-3 headset from **Control-onics Corporation** weighs 1½ ounces and has an adjustable metal boom with a noise-canceling electret mic.

Circle (468) on Fast Fact Card

Steel mounts adapt to various MDTs

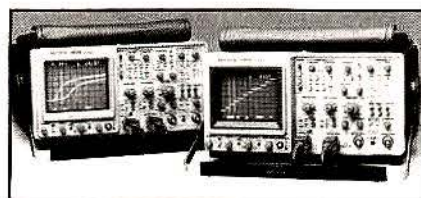


The mobile data terminal base series heavy gauge steel mounts from **Gamber-Johnson** have swivel and tilt mount adjustments. A basic mounting unit accepts different mounting plates to accommodate various mobile data terminal models. Various bases are available for installation in different types of vehicles. Optional racks provide space for additional equipment. Specialized designs can be made to fit individual requirements.

Circle (480) on Fast Fact Card

400MHz scope incorporates automatic measurements

The **Tektronix 2400B** 400MHz series oscilloscope performs automatic, push-button waveform measurements. Waveform variations, frequency and voltage can be measured automatically on repetitive signals with the push of a button. A range of options is available for the 2400B series scopes.



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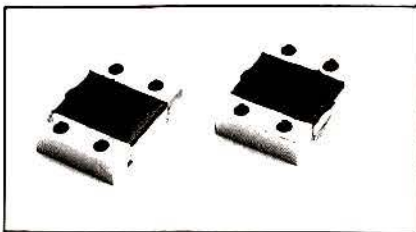
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Circle (64) on Fast Fact Card

New products

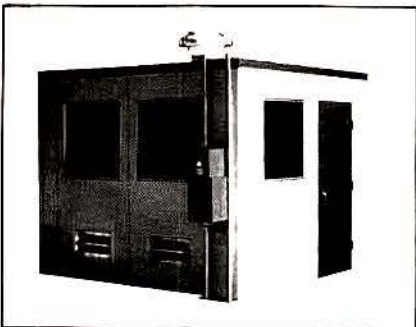
**10W, 125W, 250W
attenuators, terminations
are offered**



JFW Industries' thick microstrip attenuators and terminators are available in 10W, 125W and 250W models. Other configurations and specifications are available.

Circle (460) on Fast Fact Card

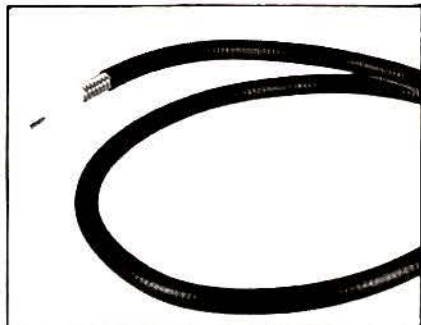
**Modular buildings feature
controlled environment**



Durable, modular buildings with controlled environments by **Environment Buildings** feature an air-tight structure. The equipment shelters have environmental control options, and the exterior can be aluminum or galvanized steel. Various sizes are available.

Circle (267) on Fast Fact Card

**Flexible cable has
waterproof connectors**



The flexible HCF 12-50J Cu2Y Cellflex coaxial cable from **Cablewave Systems** has a stranded copper center conductor, foam-dielectric and a copper tube outer conductor. It features waterproof connectors and maximum frequency of 8,500MHz with an impedance level of 50Ω.

Circle (253) on Fast Fact Card

**Portable data terminal
features 40-character LCD**



The KDT840 portable data terminal from **Motorola** has a four-line by 40-character backlit LCD. The terminal is battery powered and has an integrated radio transceiver for cordless operation. The unit weighs 30 ounces.

Circle (270) on Fast Fact Card

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Circle (65) on Fast Fact Card

Locomotive radio accommodates voice, data



The Alpha 1700 VHF Clean Cab locomotive radio from Aerotron enables voice and data communications with an individual locomotive, the entire locomotive line and the entire railroad system at one time. The radio handles automatic indications such as hot box detectors, dragging detectors, engine interrogation and automatic train location. A hard copy of all transmissions is available via an onboard printer interfaced through an RS-232 port.

Circle (472) on Fast Fact Card

2GHz testers offer manual, automatic modes



Models CMT 53 and CMT 55 2GHz radiocommunications testers from Rohde & Schwarz measure from 100kHz to 2GHz. The CMT 53 does not have an oscilloscope, and the CMT 55 comes with an oscilloscope. Features include manual and automatic mode, mobile and stationary use and universal measuring.

Circle (457) on Fast Fact Card

Telemetry unit uses packet radio technology

The TM-1200 packet radio telemetry unit from Kantronics features integrated remote telemetry circuitry and RTU interfacing.

Circle (145) on Fast Fact Card

Display pager comes with mail drop function

The PGR7000 information display pager from NEC America receives complete sentences, addresses and full messages. It features a mail drop function that allows receipt of stock market reports, commodity prices, weather reports and other data. The pager has a 32-character display and holds 40 mes-

sages with as many as 2,200 total characters. The unit's memory backup protects as many as 39 messages in storage. An alert tone informs the subscriber of a transmitted message. The pager is available with several message alert options.

Circle (474) on Fast Fact Card

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Circle (86) on Fast Fact Card

New products

Dc-to-dc converters provide up to 420W power



The series 1500 dc-to-dc converters from **Wilmore Electronics** provide as much as 420W for rack-mount applications. The single-output converters provide an isolated, regulated 12V, 24V or 48V at maximum currents ranging from 4A to 30A. Units may be used in parallel for redundancy or additional power.

Circle (250) on Fast Fact Card

Telephone handset comes with built-in tone generator

The Keying Tone Handset from **Zetron** has a built-in tone generator that provides control of remote radio transmitters. The PTT tone is generated by a push bar on the



telephone handset. The unit contains an electret condenser mic, voice amplifier, clipper, antifalsing notch filter and PTT sinewave generator. All circuitry is contained on a surface-mount board that goes inside the handset to replace the carbon mic.

Circle (262) on Fast Fact Card

Cell site towers designed to be self-supporting, guyed

Guyed and self-supporting cellular towers available from **Sabre Communications** include the series 3000 KD and

BROADCAST NEWS

ANNOUNCING — the innovative disguised VHF antenna that *looks* like a normal 13 inch cellular antenna. From **STI-CO**, the good news people.



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Circle (68) on Fast Fact Card

36000 KD guyed towers, which are made of made of high-strength steel used for medium load applications. The 4800 KD and 68000 KD series are heavy-duty towers. The towers have bolted construction. The SS3T-L self-supporting tower has tubular legs and angle diagonals.

Circle (254) on Fast Fact Card

Monitoring system handles up to 32 remote stations



The Badger 481 mini master station from the Badger division of **Telecommunications Technology** monitors status conditions at as many as 32 remote stations, each with 32 alarm inputs and 16 control outputs. Monitor points can be designated as major or minor and assigned a distinct audible tone. A password-protected remote control function is standard.

Circle (263) on Fast Fact Card

Dispatch console is designed for conventional radio system



The C3 series conventional dispatch console from **General Electric** comes in the traditional modular console form or in a desktop console. Features include radio control modules with alphanumeric display, dispatcher programmable radio users' database and interface with multiple communications equipment and formats. Same-day setup and operation is standard.

Circle (188) on Fast Fact Card

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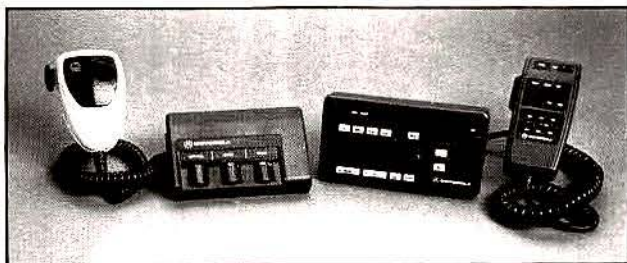
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Circle (70) on Fast Fact Card

New products

Mobile mounts remotely, offers 100W RF output



The MaraTrac mobile from **Motorola** offers 100W RF output in UHF and VHF. The radio can be mounted remotely, and broadband operation is available in eight-, 16- or 99-channel operation. The basic model has a rotary-type control head; the hand-held unit combines the control head and mic with a two-digit LED display. The unit's channel scan feature lets users define their own scan lists with modification when needed.

Circle (251) on Fast Fact Card

Transmitter controller prevents falsing

Model 66 transmitter control panel from **Zetron** can be connected to any brand of radiopaging transmitter. The unit's



continuous-tone control method prevents falsing. Time-out timers protect transmitters from extended key-up. The unit mounts in a standard 19-inch rack and operates on 12Vdc to 14Vdc or optional 110Vac wall transformer.

Circle (260) on Fast Fact Card

Computer programs generate RF site studies

Base station antenna customers of **Antenna Specialists** can obtain site management computer programs. The two programs can generate accurate site studies when appropriate data are entered. One program produces precise pattern predictions for determination of the optimum installation parameters for side tower mounted omnidirectional antennas. The other program provides a full site intermod

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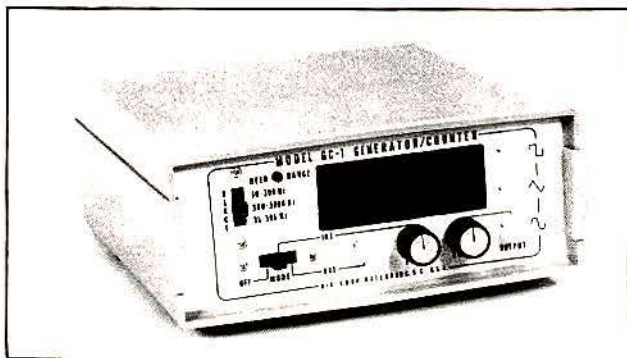
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Circle (72) on Fast Fact Card

study when all Tx frequencies in a given area are provided and the Rx frequencies are known.

Circle (252) on Fast Fact Card

Generator-counter covers 30Hz to 30kHz



Model GC-1 generator-counter from Automated Industrial Electronics Corporation covers 30Hz to 30kHz. In internal mode operation, the output frequency is displayed by five LEDs. In external mode operation, the unit becomes a high-speed counter.

Circle (258) on Fast Fact Card

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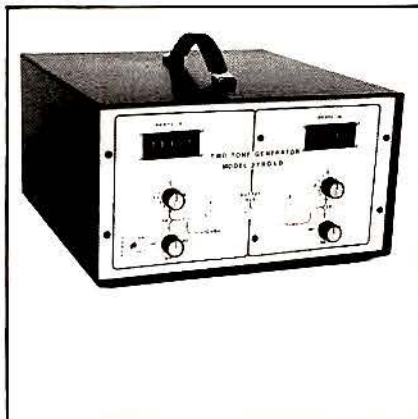
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Circle (76) on Fast Fact Card

New products

**Two-tone generator
has wide frequency range**



Model 2TSG-LD two-tone generator from **Automated Industrial Electronics Corporation** consists of two independent generators that can be set separately for frequency and output level. The unit features low distortion, wide frequency range, low intermod distortion and output of +10dBm.

Circle (257) on Fast Fact Card

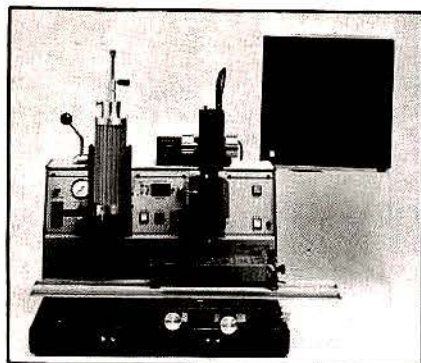
**Crystal-controlled radio
covers 6 channels**



The Communicator hand-held from **T-Berry Electronics** features 5W and six channels. The crystal-controlled unit is available for VHF or UHF and comes with a 9.6V, 500mAh nickel-cadmium battery pack, wall-mount battery chargers and flexible antenna. The two-way radio has a high-low power switch and weighs 20 ounces.

Circle (489) on Fast Fact Card

SMD repair system uses two work centers



The Pace Craft-25 surface-mount repair system performs fine-pitch installation and removal of surface-mount devices with spacing as low as 10-pitch. The system uses two work centers; one with a closed-circuit camera and monitor that features a vacuum-pick. The second center features an air and gas reflow heater. An x-y-theta table allows precise component setup and movement between the reflow center and component prep and replacement station.

Circle (471) on Fast Fact Card

Power meters are available for analog, digital tests

Two power meters, a digital RF power meter and a compact, RF analog power meter, are available from Marconi Instruments. The power meters cover a dynamic range of 0.1mW to 100mW at frequencies from dc to millimetric waves. The digital unit, model 6960, provides GPIB operation and high accuracy because sensor power linearity and frequency response errors can be corrected. Model 6950, the analog unit, has a rotary switch that enables 10 ranges to be selected in 5dB steps. Sensors have 50Ω or 75Ω capability.

Circle (453) on Fast Fact Card

Solar energy powers 18GHz microwave repeater

The RF-18000 18GHz microwave RF repeater from Peninsula Engineering Group is solar-powered and operates in the 17.7GHz to 19.7GHz band. It features remote alarm reporting and has 60dB gain and +20dBm maximum power output.

Circle (454) on Fast Fact Card

ID and status console shows 6 calls at a time

The MBD-5 Star system display console from Coded Communications automatically identifies every caller and displays status updates. Multiple window displays show the most recent six calls received. An audio tone alerts the dispatcher of an incoming coded message. Optional computer interface and CRT video display are available.

Circle (451) on Fast Fact Card

Expanded mic line comes with prewired connectors

The expanded CES 600L and 700 series of radio compatible mics now include E. F. Johnson, Kenwood and Maxon radios. The 600L manual dialing DTMF encoder mic and the 700 memory dialer with ANI are available with prewired connectors for expanded radios.

Circle (477) on Fast Fact Card

UHF portable operates over 20MHz bandwidth



The 16-channel UHF hand-held from Telemobile operates over a 20MHz bandwidth with power output switchable from 1W to 5W transmit. A mobile charger accessory that boosts the power to 15W is available.

Circle (440) on Fast Fact Card

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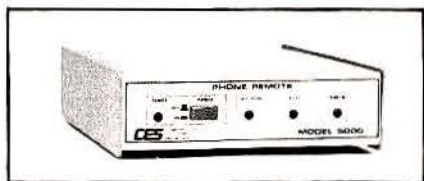
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Circle (77) on Fast Fact Card

New products

Telephone remote offers call limit timers



Circle (476) on Fast Fact Card

The CES 5000C telephone remote allows base station control from DTMF telephones. The unit has programmable activity and call limit timers. Calls can be initiated from the mobile with three PTT bursts that enable the 5000C to dial a preprogrammed number.

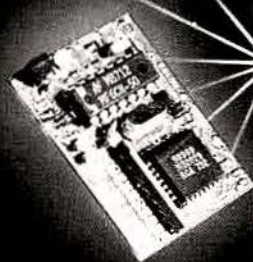
Batteries in headsets have extended life



The Balanced Power feature in series 3 and 3W headsets from Earmark assures the balanced discharge of the two batteries in the system and provides an extended period of battery life. With the feature, the expected time between battery changes is approximately doubled, and both batteries will require changing at the same time.

Circle (459) on Fast Fact Card

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Circle (78) on Fast Fact Card

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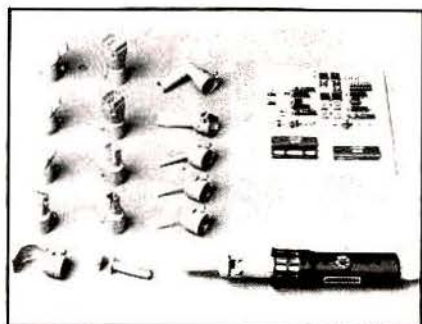
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Circle (79) on Fast Fact Card

Solder tool de-solders surface-mount devices



The Leister Labor 'S' hot-air solder tool from Brian R. White Company produces contact-free soldering of electronic components. It de-solders SMD and DIP components in two to four seconds. It can shrink tubing, solder sleeves and test component welds. More than 60 nozzle types are in stock.

Circle (432) on Fast Fact Card

Receiver spans all bands used for public service



ACE Communications' 100-channel scanning receiver covers all bands in public service including 27MHz to 54MHz, 108MHz to 174MHz, 406MHz to 512MHz and 830MHz to 950MHz. Model AR900 weighs 12 ounces and comes with a belt clip and a 450mAh rechargeable battery. The unit has 25 front-panel keys that enable programming of five banks of 20 channels.

Circle (464) on Fast Fact Card

Test clips are used for small components



Minipincer test clips from Pomona Electronics provide test point contact for standard DIP ICs, among other miniature components. The clip attaches to a selected test point by a pincer-type contact. Pincer contacts are gold-plated phosphor bronze. Seven models of test clips are offered.

Circle (449) on Fast Fact Card

Software calculates paths for multiple address systems

The Multipoint SCADA software package from Technical Communications Software features advanced editing techniques, file retrieval and storage, an escape menu and error detection. The programs provide path calculations between a master station and re-

mote stations and include fade margin based upon equipment specifications, transmission line lengths and antenna characteristics. Calculations use the dipole antenna as a reference. A user's manual comes with the programs.

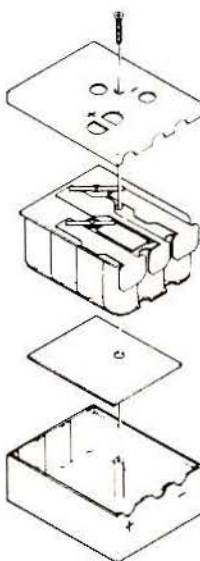
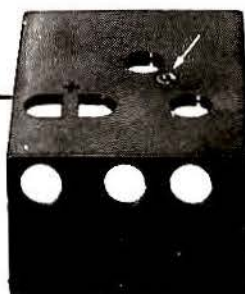
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Circle (80) on Fast Fact Card

New products

Nationwide pager features alphanumeric messaging

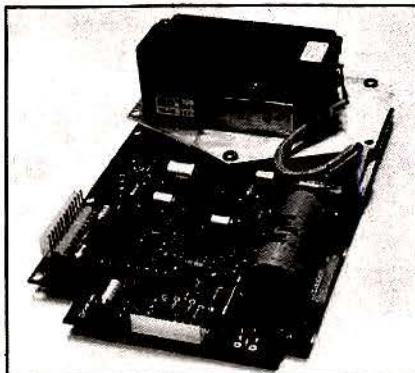
The PGR9000 nationwide pager from NEC America combines alphanumeric messaging with scanning technology. Messages are displayed on a two-line, 5x7 dot matrix display with 16 characters per line. The unit's 2,200 character memory can hold as many as 40 messages. A small, rechargeable battery

provides memory backup when the pager is off. With the pager, carriers can suspend service to a user by transmitting a special code that the subscriber cannot override. A release code can be transmitted to resume service.

Circle (473) on Fast Fact Card

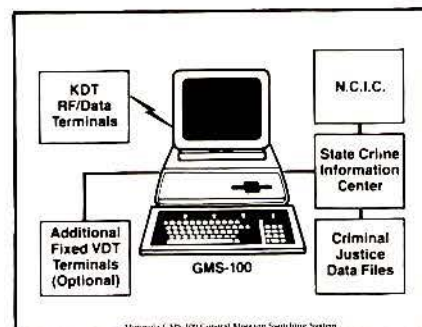
Computer modem transmits data via two-way radio

The TEM-Link modem allows computers to receive and transmit data over RF. Made by Tauber Electronics, the modem works with any radio operating on UHF public access frequencies. The modem plugs into existing computer chassis or a separate enclosure can be provided. The company will determine a user's radio type, baud rate, data connections, operation mode, power source and packaging requirement. Phone hookups and other peripherals are not needed with the modem.



Circle (208) on Fast Fact Card

Message switch is suited for public safety use



The GMS-100 message switch from Motorola monitors and displays the status of units in the field, as well as providing unit-to-unit messaging and logs all selected message types. It provides limited dispatch backup when the host computer fails. The message switch supports 100 to 150 mobile and portable radio data terminals, as many as five VDTs and as many as two host computers.

Circle (268) on Fast Fact Card

MOBILE ENCODERS AND DECODERS



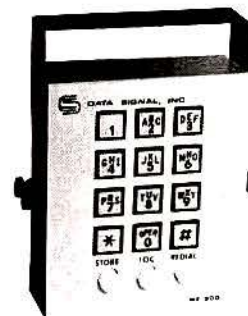
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- Programmable ANI speeds



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Circle (81) on Fast Fact Card

Step attenuator spans dc to 1GHz

Model M1600 step attenuator from **Automated Industrial Electronics Corporation** is compact and portable. Frequency range is from dc to 1GHz. The unit weighs 1¼ pounds.

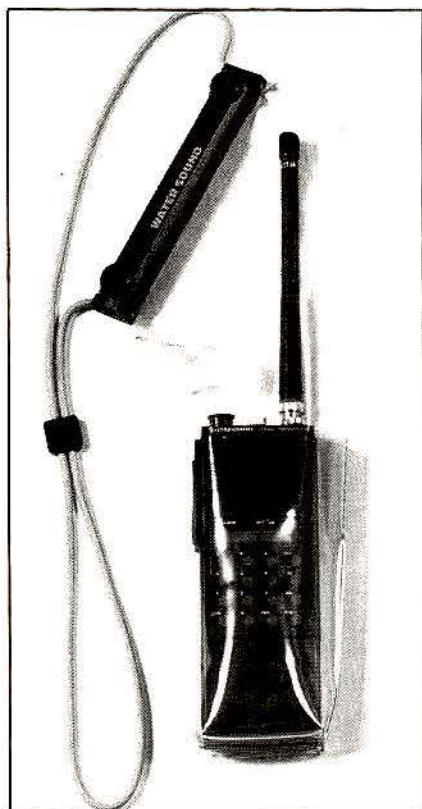
Circle (259) on Fast Fact Card

Detector finds 'bugs'

The Transtec unit from **Torfind Enterprises** detects concealed RF transmitter "bugs." It allows a concealed and sweep mode and has a monitoring feature to hear transmissions while sweeping for bugs. The unit operates in the 20MHz-to-1.0GHz band.

Circle (306) on Fast Fact Card

Waterproof case fits VHF portables

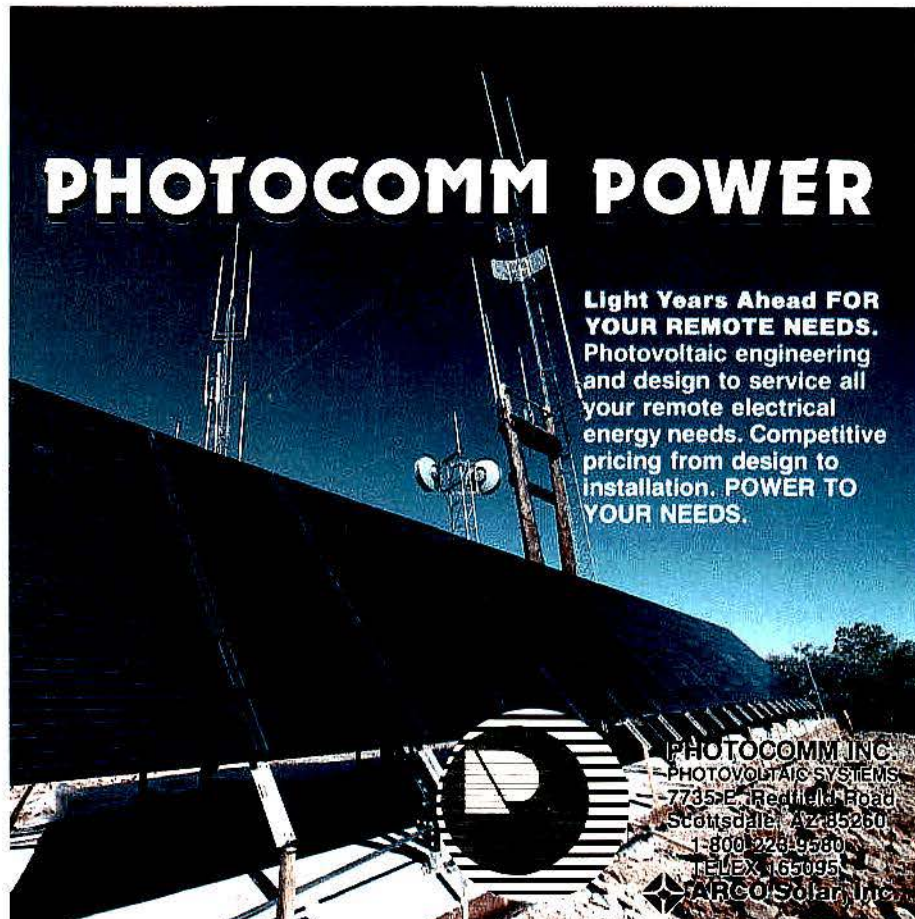


The Watersound VHF transparent case from **EWA-Marine** protects VHF hand-holds from saltwater spray without disrupting radio operation through the housing. The standard size fits marine VHF radios, and a larger size fits land-based VHF units.

Circle (456) on Fast Fact Card

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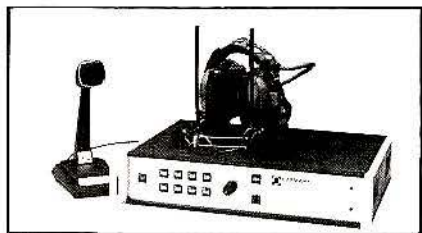
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Circle (83) on Fast Fact Card

New products

Repeater base station offers backup power



Circle (463) on Fast Fact Card

Earmark's repeater base station is rack-mountable and contains a built-in rechargeable battery for emergency use or portable operations. It can support eight remote stations. Each remote station is equipped with the Range Alert feature that indicates when a remote station is out of range or off the air.

Innovation protects guylines from damage

The Guyline Guardian from **Hughey & Phillips** shields preforms on guyed towers from ice damage and vandalism. The device bolts around the guyline preform and splits ice that slides down guylines. The protection device's self-locking bolts are difficult to undo, and, therefore, discourage vandalism. Units are available in guy sizes ranging from 5/16" to 1".

Circle (466) on Fast Fact Card

SMR billing software supports flexible tax rates

The EzBill billing system for Motorola SMR operators from **Triad Operations** can bill as many as six systems on one invoice. The software package enables automatic billing for interconnect charges and flexible tax rates. It supports monthly, quarterly, semiannual, annual and one-time billing entries. The software also supports Hark seven-digit dialing codes. Telephone support is available.

Circle (465) on Fast Fact Card

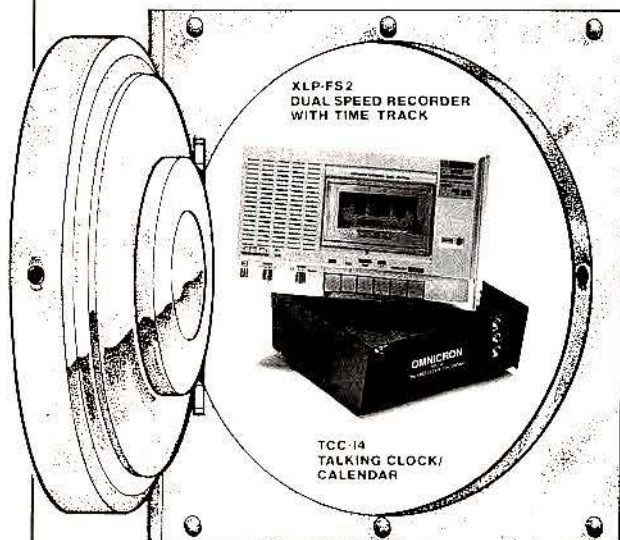
Software for radios speeds access time



Turbo software is incorporated in Repco's trunked RHT-800 portable and RMT-800 mobile. The faster software steps up access time and performance.

Circle (435) on Fast Fact Card

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Circle (85) on Fast Fact Card

Cell site towers designed to be self-supporting, guyed

Guyed and self-supporting cellular towers available from **Sabre Communications** include the series 3000 KD and 36000 KD guyed towers, which are made of made of high-strength steel used for medium load applications. The 4800 KD and 68000 KD series are heavy-duty towers. The towers have bolted construction. The SS3T-L self-supporting tower has tubular legs and angle diagonals.

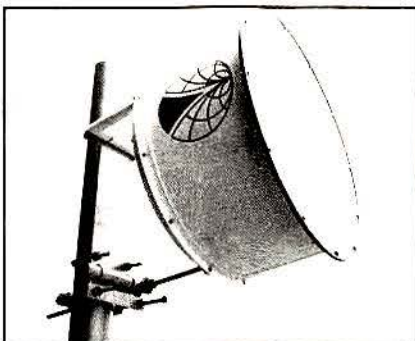
Circle (262) on Fast Fact Card

Datalink controller suits military specs

Dataradio's military modem-datalink controller features messaging priority over the radio network with up to 16 precedence levels. Four levels of message priority are incorporated in standard models, including routine, immediate, priority and flash.

Circle (470) on Fast Fact Card

Single-, dual-polarized antennas are offered



Dual-polarized 18GHz and 23GHz microwave parabolic antennas are available from **Mark Antennas Division of Radiation Systems**. Standard and high-performance 2-, 4- and 6-foot antennas are offered in both frequency ranges and in single-polarized models. The antennas feature spun aluminum reflectors and can be painted to blend into surroundings.

Circle (255) on Fast Fact Card



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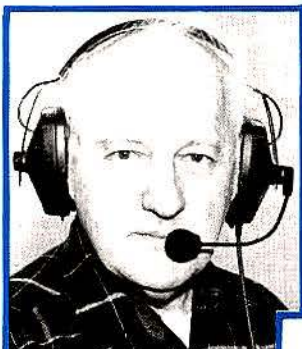
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Circle (87) on Fast Fact Card

Communications laws compiled in booklet

"Compilation of the Communications Act of 1934 and Related Provisions of Law" has been released by the **Government Printing Office**. Published by the House Energy and Commerce Committee, it contains major communications bills enacted into law in recent years, including the Cable Communications Policy Act of 1984 and the Electronic Pri-

vacy Act of 1986, among others. The publication, stock no. 052-070-06473-1, sells for \$11. It can be ordered from the Superintendent of Documents, Attention: Government Printing Office, Washington, DC 20402. Credit card orders may be telephoned via 202-783-3238.

Circle (411) on Fast Fact Card

Publication includes FCC rules and regulations

Equipment Rules Service includes a looseleaf reference volume with the full text of several "Parts" of FCC rules and regulations:

- Part 2—Frequency Allocations and Radio Treaty Matters.
- Part 5—Experimental Radio Services (other than Broadcast).
- Part 15—Radio Frequency Devices.
- Part 18—Industrial, Scientific and Medical Equipment.
- Part 68—Connection of Terminal Equipment to the Telephone Network.

Published by **Pike and Fischer**, the reference volume also contains the text of current notices of proposed rulemaking affecting Parts 2, 5, 15, 18 and 68; an alphabetical index; and copies of FCC forms.

The FCC materials are updated bi-monthly. Each update includes a newsletter that discusses commission rulemakings and summarizes government actions affecting the manufacturing of commercial radio frequency devices and telecommunications equipment.

Circle (514) on Fast Fact Card

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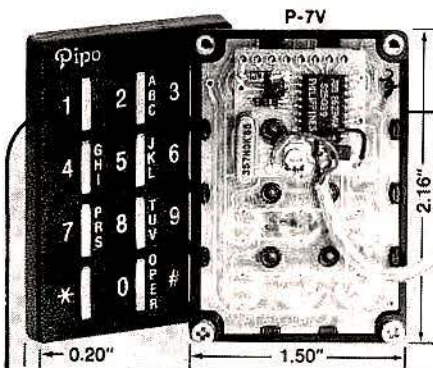
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Circle (90) on Fast Fact Card

RF products catalog lists dividers, combiners, amplifiers

A short form catalog released by **Janel Labs** has products designed for HF, VHF, UHF, land mobile and telemetry applications. Models include two-to 18-way power dividers and combiners; receiver amplifiers with high dynamic range; wideband, low-power modular amplifiers; and a new series of high-power, high-gain linear amplifiers. The catalog has tabular product specification listings, package considerations and ordering information.

Circle (312) on Fast Fact Card

Brochure describes mobile equipment line

A 12-page color brochure describes the **Midland** line of land mobile two-way radio equipment. More than 200 models are included among Syn-Tech and Syn-Tech II units, base station repeaters and CMS 800MHz Channel Management System equipment for specialized mobile radio service.

Circle (221) on Fast Fact Card

Institute standard covers mobile digital equipment

The National Institute of Justice has published minimum performance standards for evaluating mobile digital equipment. NIJ Standard-0215.01, Mobile Digital Equipment, revises a previous standard published in May 1983. It includes improvements in transmission speed, information throughput and

error sensitivity measurements. Other characteristics measured include message duration, audio distortion loading, display readability and display memory retention. Temperature and humidity tests also are specified.

Circle (407) on Fast Fact Card

Bulletin lists test and measurement seminars

Hewlett-Packard is conducting more than 30 test and measurement seminars intended to provide a better understanding of fundamental concepts and proper measurement techniques. A bulletin released by the company lists the meetings, which are offered at several locations. Topics include spectrum analyzers, network analyzers, signal generators, communications test, microwave measurements, fiber optics test and general measurement.

Circle (405) on Fast Fact Card

FCC Part 90 rules

The National Association of Business and Educational Radio has published the 1988 edition of its *FCC Rules and Regulations: Part 90*. The edition is current through March 1, 1988. It includes a reference guide with names, addresses and telephone numbers of every Part 90 frequency coordinating committee. It also lists FCC private radio bureau offices in Washington, DC, and Gettysburg, PA, as well as field operations bureau offices throughout the country.

Circle (409) on Fast Fact Card

Radio and pager batteries are listed in 32-page catalog

The 1988 "Radio/Pager Battery Catalog" from Alexander Batteries lists replacement batteries for portable two-way radios and pagers, associated battery chargers and analyzers, radio antennas, cordless phone batteries, medical equipment batteries, backup system batteries and survey equipment batteries. It includes more than 50 new batteries with cross-references to more than 500 pieces of equipment.

Circle (220) on Fast Fact Card

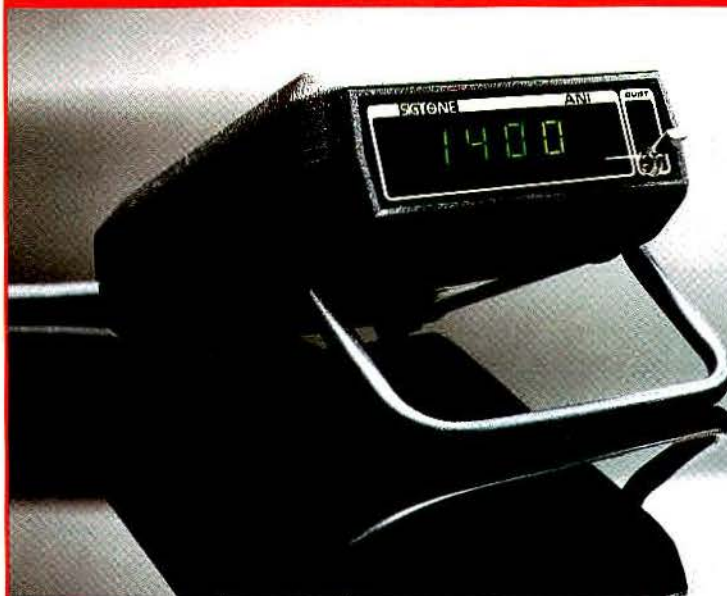
Video tape features communication systems

A new video tape illustrates Earmark communication systems and specific job applications. The nine-minute VHS video describes headsets, belt packs, base station systems and the company's Loudmouth product.

Circle (498) on Fast Fact Card



Affordable efficiency



SIGTONE'S new Automatic Number Identification (ANI) offers you a low-cost opportunity to vastly improve the efficiency of your mobile radio fleet operations:

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Sigtone, Inc. specializes in high quality, high performance, tone signalling products for radio communication.

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Circle (91) on Fast Fact Card

More than one-third order equipment at shows

Although trade shows in land mobile seem to dominate the fall and spring seasons, the busy schedule benefits those who attend, according to results of the March "What Do You Think?" questionnaire. More than one-third of the respondents order equipment at trade shows.

The opportunity to see equipment on display affects trade show attendance, according to 51% of the respondents. So does the cost to attend a show. Factors affecting the decision to attend include:

| FACTORS | % |
|--------------------------------------|------|
| Location | 81.9 |
| Cost to attend | 51.1 |
| Equipment on exhibition | 51.1 |
| Dates of event | 46.8 |
| Seminar schedule | 26.6 |
| Visiting with industry acquaintances | 21.3 |

The location of a trade show influences attendance: 81.9% of the respondents specified location as the most important factor influencing the decision whether to attend.

Readers attend IMCE, APCO, Telocator Spring and Fall, ENTELEC, NABER, UTC, Expo/East, SIRSA and other shows. The most popular shows attended by readers are IMCE with 52.1% of the respondents attending, Expo/East with 46.8% response, APCO with 40.4% and Telocator with 13.8%.

If they could change anything they wanted to about trade shows, respondents would change the number of trade shows held each year. More shows are favored by 16% of the respondents, and fewer shows are desired by 21.2% of the respondents.

Show exhibition hours also would be changed by some readers. Most respondents, 26.5%, favor longer show hours. A mere 4.3% want shorter hours. Respondents also would change seminar

topics and scheduling.

Readers would like to see trade shows that are closer to their areas. "I'd like to see some on the East Coast—nuts to Las Vegas," a respondent said.

Other changes advocated for trade shows from reader comments include: "Free exhibits open to the public." "Exhibits only on Saturday and Sunday; seminars on Monday." "April is our busy month; change shows to January or November."

"Keep end-users out. Make shows for dealers only." "There is a need for new seminar topics." "Road shows." "Need good technical information on products at the show."

For a look at upcoming trade shows in land mobile, see "Calendar" on page 88.

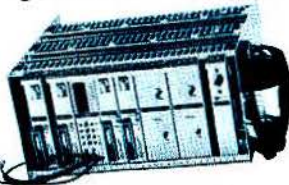


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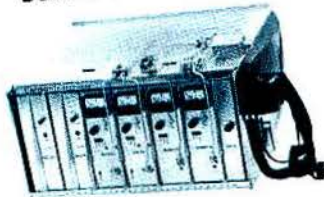
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Circle (92) on Fast Fact Card



Sanders



Hurley



Bloss



Miles

J.C. Sanders, product planning manager, high-tier portables, Motorola, Ft. Lauderdale, FL, joins Maxon Electronics, Kansas City, MO, as new products manager.

John J. Hurley, senior vice president of Antenna Specialists, Cleveland, joins Glenayre Electronics, Vancouver, British Columbia, as president.

Alice F. Bloss, general manager of Fidelco Communications' New Jersey office, joins Midland as area sales manager for Delaware, Maryland, New Jersey, Virginia, Washington, New York City and eastern Pennsylvania. **Dwala Miles** advances from marketing coordinator to marketing and sales supervisor.

Russ Allen, corporate sales manager for RF products and international sales manager for the Asia-Pacific regions, Glenayre Electronics, Vancouver, British Columbia, moves up to director of international sales.

Related changes at Kustom Electronics, Lenexa, KS, resulting from Glenayre's acquisition of a 58% interest in the company: **Cecil Van Tuyl** resigns as chairman; Glenayre chairman **L. Claude Simmonds** assumes responsibility as chief executive officer; Kustom vice chairman **Lyle Phillips** remains, but relinquishes the chief executive designation. Directors **Robert W. McFadden**, **F.L. Thompson** and **J. Wesley St. Clair** resign.

T.R. "Ted" Faust, director of product management for paging and IMTS terminals, BBL Industries, Atlanta, joins Commonwealth Communications Industries, Ashland, VA, as vice president of sales and marketing.

Promotions at Communications Electronic Specialties, Winter Park, FL: **Richard C. Legge Jr.**, to vice president of business development; **David B. Johnson**, to director of engineering; and **Walter J. Corrigan**, to manager of sales and marketing.

J. Ted McDonald, vice president and general manager of Deterline, joins Repco, Orlando, FL, as manager of contracts. **Brian Moisand**, director of corporate development for a new venture division of North American Telephone, joins Repco as director of marketing.

Todd Ellis, sales representative for Computerland, Rochester, NY, joins Repco as northeast regional account executive, with an office in Rochester.

Jim Layne, director of CMS sales, TacTel Systems, joins Repco, Orlando, FL, as national account executive for telemetry products.



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Circle (96) on Fast Fact Card

Calendar

September

28-Oct. 1—Telocator Network of America 40th Annual Convention and Exposition, Rivergate Convention Center, New Orleans. Contact: 202-467-4770.

October

3-4—American SMR Network Association Meeting, Alameda Plaza Hotel, Kansas City, MO. Contact: 202-331-7773.

9-12—National Association of Business and Educational Radio Mid-Year Meeting, Radisson Mark Hotel, Alexandria, VA. Contact: 800-759-0300.

15-20—International Association of Police Chiefs Annual Meeting, Portland Coliseum, Portland, OR. Contact: 301-948-0922.

19-22—Special Industrial Radio Service Association Annual Meeting, Buena Vista Hotel, Orlando, FL. Contact: 703-528-5115.

November

19—NABER Technician Certification Exam, various locations. Contact: 800-759-0300.

19—Radio Club of America Annual Meeting and Awards Banquet, New York Athletic Club, New York. Contact: 201-246-7271.

January

23-25, 1989—Cellular Telecommunications Industry Association 1989 Winter Meeting and Exposition, San Antonio Marriott Rivercenter, San Antonio, TX. Contact: 202-785-0081.

30-31, 1989—American SMR Network Association Expo and Winter Membership Meeting, Lake Buena Vista Palace, Orlando, FL. Contact: 202-331-7773.

March

15-18, 1989—National Association of Business and Educational Radio 1989 Annual Meeting, New Orleans Hilton, New Orleans. Contact: 703-739-0300.

19-22, 1989—Energy Telecommunications and Electrical Association '89, Louisiana Superdome, Hyatt Regency, New Orleans. Contact: 214-578-1900.

29-31, 1989—International Mobile Communications Expo, Las Vegas Convention Center, Las Vegas, NV. Contact: 303-220-0600.

May

3-5, 1989—Telocator Spring Meeting, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 202-467-4770.



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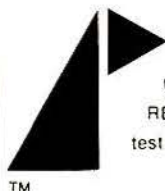
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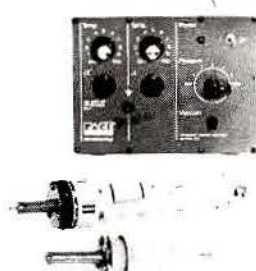
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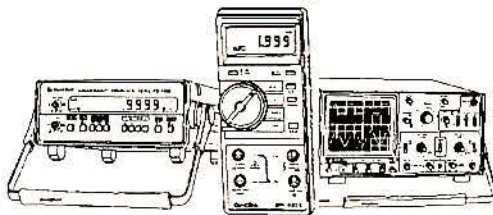
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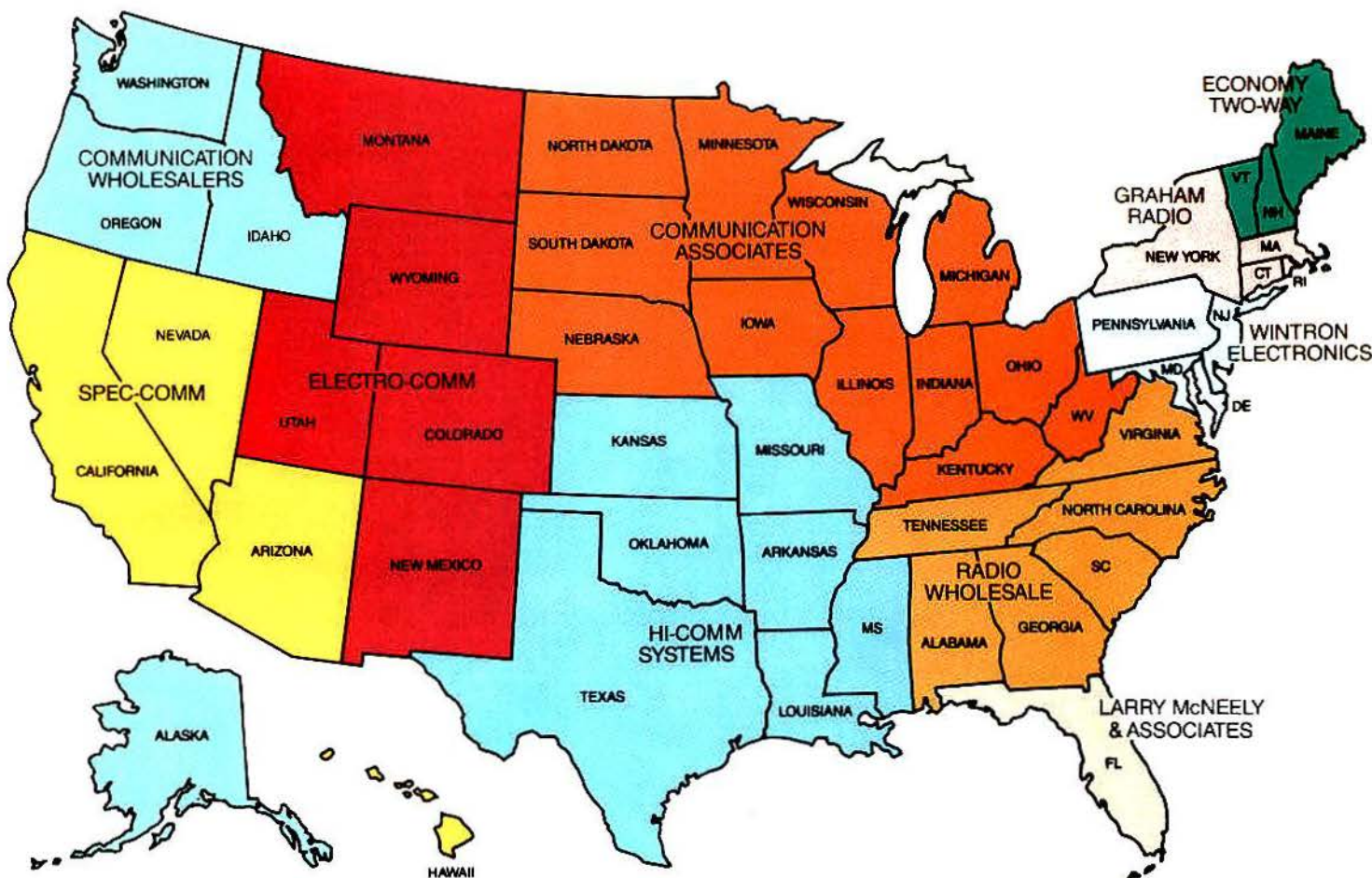
JAPAN:

Masayoshi Yoshikawa
Orient Echo, Inc.
1101 Grand Maison
Shimomiyabi-Cho, 2-18
Shinjuku-ku,
Tokyo 162 Japan
Telephone: 03-235-5961
Telex: J-33376 MYORIENT

Ad index/hotline

| Company | Page Number | Fast Fact Number | Advertiser Hotline | Company | Page Number | Fast Fact Number | Advertiser Hotline |
|---|-------------|------------------|--------------------|----------------------------------|-------------|------------------|--------------------|
| Advanced Electronic Applications Inc. | 75 | 74 | 206/775-7373 | Maxrad Inc. | 69 | 63 | 312/595-3933 |
| Advanced Receiver Research | 18 | 14 | 203/582-9409 | Midian Electronics, Inc. | 38 | 28 | 602/884-7981 |
| AIE Corp. (Automated Industrial) | 78 | 79 | 803/532-9256 | Midland International LMR | 25 | 18 | 800/MID-LAND |
| Antenna Specialists Co. | IFC,52 | 1,44 | 216/349-8400 | Modublox & Co. Inc. | 88 | 95 | 619/456-0016 |
| B-D Crystal | 91 | 100 | 513/522-3300 | Motorola Govt. Elec. Group | 51 | 43 | 800/367-2346 |
| Band-It-Idex | 32 | 23 | 303/320-4555 | Multiplier Industries Corp. | 14 | 11 | 800/642-2424 |
| Barnett Electronics | 92 | 101 | 800/423-3858 | MX-COM Inc. | 35 | 25 | 919/744-5050 |
| Battery Pak Sales & Service | 89 | 98 | 800/245-1138 | NCE/Power Group Products | 79 | 80 | 612/890-1360 |
| Beam Radio | 36 | 26 | 305/477-2326 | Neutec Division of Celltronics | 67 | 60 | 619/587-0656 |
| Bee Electronics Inc. | 75 | 73 | 800/336-3115 | Norcomm Corp. | 78 | 78 | 800/874-8663 |
| Bomar Crystal Co. | 64 | 57 | 800/526-3935 | Omnicon Electronics | 82 | 84 | 203/928-0377 |
| Bramco | 87 | 93 | 513/773-6255 | Pac-Comm Wireless Data Sys. Inc. | 42 | 33 | 813/875-6417 |
| BYTEK Corporation | 66 | 58 | 800/523-1565 | Pace Inc. | 73 | 70 | 301/490-9860 |
| C T Systems | 11,45 | 9,36 | 800/245-6356 | Panasonic Industrial Co. | 13 | 10 | 201/348-7933 |
| California Radio | 91,93 | 102,103 | 800/231-0103 | Parkinson Electronics | 91 | 107 | 800/332-7003 |
| Centurion International, Inc. | 43 | 34 | 800/228-4563 | Photocomm Inc. | 81 | 82 | 800/223-9580 |
| CES Inc. | 7,70 | 7,64 | 800/327-9956 | Pipo Communications | 84 | 90 | 916/644-5444 |
| Cetec Vega | 1 | 4 | 818/442-0782 | Polyphaser Corp. | 72 | 68 | 702/782-2511 |
| Don Cline & Associates | 63 | 69 | 800/228-0867 | Primus Electronics Corp. | 87,93 | 94,108 | 800/435-1636 |
| Coded Communications | 37 | 27 | 800/325-0147 | Quintron Corp. | 57 | 49 | 217/223-3225 |
| Commonwealth Communications Industries Ltd. | 47 | 38 | 800/633-8844 | R F Industries | 81 | 83 | 800/233-1728 |
| Communications Associates | 60,92 | 53,104 | 800/435-9313 | Raven Electronics Corp. | 58 | 51 | 702/359-3700 |
| Communications Specialists | BC | 3 | 800/854-0547 | Reach Electronics | 83 | 86 | 308/324-6661 |
| Connect Systems Inc. | 19 | 15 | 213/373-6803 | Repco Inc. | 23 | 17 | 305/843-8484 |
| Control Signal Corp. | 48 | 39 | 303/989-8000 | Savoy Electronics Inc. | 82 | 85 | 800/327-1282 |
| Controlonics Corporation | 83 | 87 | 800/233-8639 | Securitron Co. | 52 | 45 | 408/263-6434 |
| Cortana Corp. | 68 | 61 | 505/325-5336 | Selectone Corp. | 41 | 32 | 800/227-0376 |
| Curtis Electro Devices, Inc. | 88 | 96 | 800/332-2790 | Setcom Corp. | 74 | 72 | 415/965-8020 |
| Cushcraft Corp. Signals | 77 | 77 | 603/627-7877 | Shinwa Communications of Am. | 53 | 46 | 405/232-7272 |
| Data Signal Inc. | 80 | 81 | 912/883-4703 | Shure Brothers Inc. | 61,63,65 | 55 | 800/257-4873 |
| EMR Corp. | 50 | 41 | 602/978-5766 | Sigtone Inc. | 85 | 91 | 213/463-4474 |
| Erie Electronics, Inc. | 68 | 62 | 716/833-8400 | SMC Electro-Mount | 44 | 35 | 800/527-1079 |
| Fujitsu Ten Corp. of America | 29 | 20 | 800/421-1996 | Solid State Communications | 3 | 5 | 415/785-4610 |
| General Communications Inc. | 76 | 75 | 800/356-3200 | Sound Quest | 94 | 109 | 800/457-4579 |
| Glenayre Electronics | 33 | 24 | 206/575-0888 | Standard Communications Corp. | 55 | 47 | 213/532-5300 |
| Helper Instruments Co. | 70,84 | 65,88 | 800/327-9308 | Sti-Co Industries Inc. | 72 | 67 | 716/881-3287 |
| Henry Radio | 76 | 76 | 213/820-1234 | Sweet Electronics | 89 | 97 | 618/939-3870 |
| Hi-Com Systems Inc. | 91 | 105 | 800/444-7077 | Synthex Communications USA | 30 | 21 | 702/731-1516 |
| Hutton Communications | 56 | 48 | 800/442-3811 | Syntonic Technology | 54 | | 800/233-2365 |
| IFR Systems, Inc. | 49 | 40 | 316/522-4981 | TDI Batteries | 66 | 59 | 800/323-7307 |
| International Crystal Mfg. Co., Inc. | 39 | 29 | 405/236-3741 | Telewave Inc. | 59 | 52 | 415/968-4400 |
| International Paper | 92 | 106 | 501/836-9043 | Tessco | 58,74 | 50,74 | 800/638-7666 |
| ISC Cardion Electronics Inc. | 86 | 92 | 516/289-6200 | TPL | 61 | 54 | 213/256-3000 |
| Jan Crystals | 50 | 42 | 813/936-2397 | Transcrypt Intl. Inc. | 5 | 6 | 800/228-0226 |
| Kathrein Inc. | 10 | 8 | 216/289-1271 | TX RX Systems | 46 | 37 | 716/549-4700 |
| Kenwood U.S.A. Corporation | 15 | 12 | 213/639-9000 | Vocom Products Corp. | 84 | 89 | 312/885-3296 |
| Larsen Electronics Inc. | 27 | 19 | 206/573-2722 | W & W Associates | 71 | 66 | 800/221-0732 |
| Magnavox | 21 | 16 | 516/667-7710 | Yaesu USA | IBC | 2 | 213/404-2700 |
| Marconi Instruments | 17 | 13 | 800/233-2955 | Zetron Inc. | 31 | 22 | 206/644-1300 |
| Maxon | 62 | 56 | 816/891-6320 | | | | |

Yaesu announces national distribution...



on a regional level.

As part of our ongoing efforts to improve service to our retail dealers, Yaesu is pleased to announce an exciting new distribution plan.

Effective September 1, 1988, all Yaesu commercial products will be sold exclusively through a chain of authorized regional distributors, conveniently located throughout the country. This will ensure a consistent, local availability (at the regional level) of Yaesu products, plus closer, more rapid service for our retailers.

If you have any questions concerning this new plan, please contact your regional distributor or call Yaesu for information.

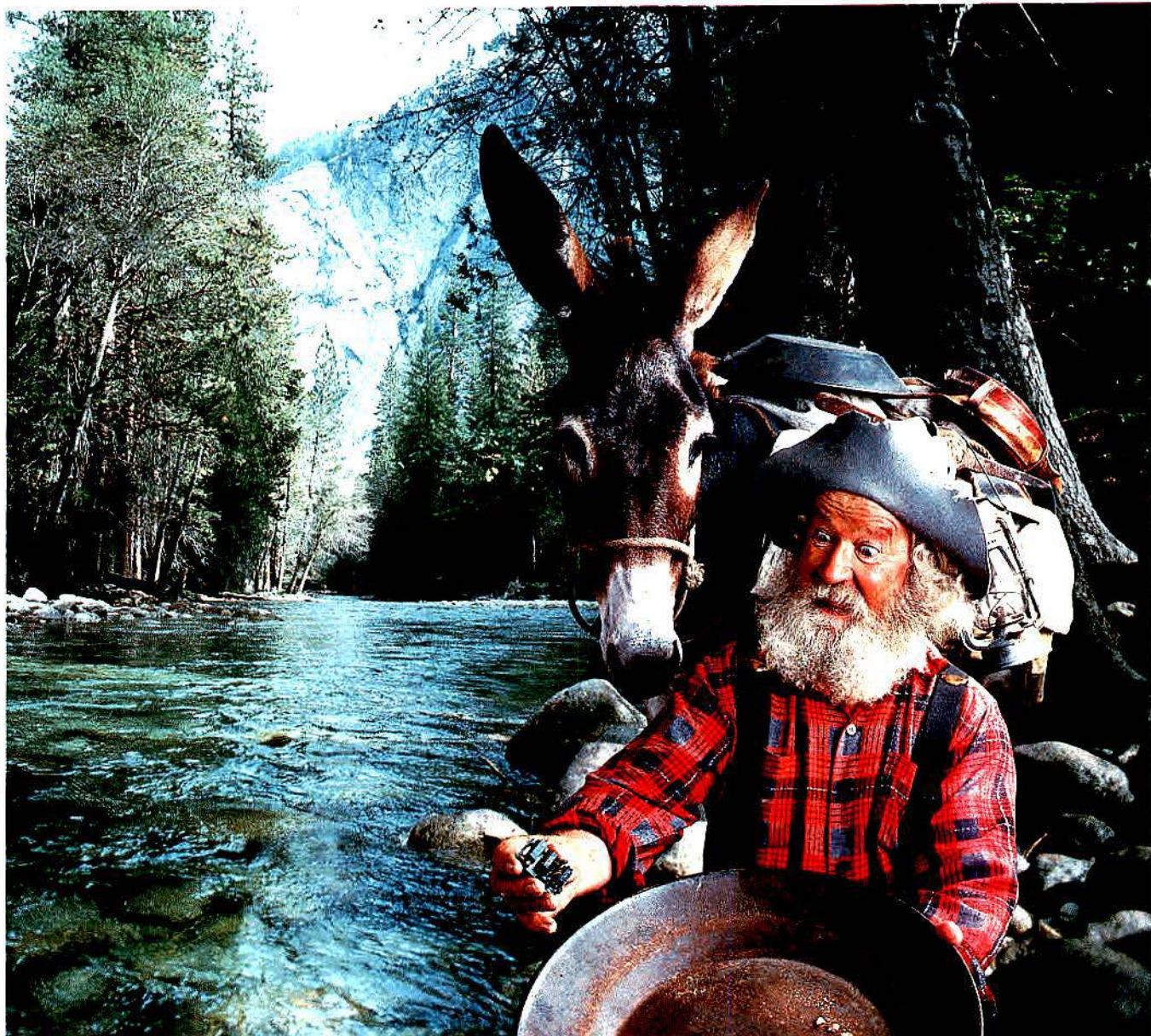
Following are the names and phone numbers of the regional distributors, keyed to the map above.

List of Distributors: ■ Spec-Comm; (714) 646-9621 ■ Communications Associates, Inc.; In IL (800) 892-1611/Outside IL (800) 435-9313 ■ Communication Wholesalers; In WA (800) 562-6539/Outside WA (800) 223-2428 ■ Economy Two-Way Distributors; In NH (603) 528-6411/Outside NH (800) 334-0700 ■ Electro-Comm Distributing, Inc.; In CO (800) 423-7949/Outside CO (800) 525-0173 ■ Graham Radio, Inc.; (617) 944-4000 ■ Hi-Comm Systems, Inc.; In TX (817) 478-6684/Outside TX (800) 444-7077 ■ Radio Wholesale; In GA (404) 561-7000/Outside GA (800) 53-RADIO Wintron Electronics; (201) 449-4850 ■ McNeely & Associates; (305) 563-0753.

YAESU U.S.A.

Commercial Products Division
17210 Edwards Rd., Cerritos, CA 90701/Telephone: (213) 404-2700

Circle (2) on Fast Fact Card



Eureka!

We just struck gold with a miniature, high quality and very reliable DTMF decoder at a rock bottom price of \$59.95. Our DTD-1 will decode 5040, 4 digit codes with the security of wrong digit reset. It contains a crystal controlled, single chip DTMF decoder that works great in bad signal to noise environments and provides latched and momentary outputs. Why carry that heavy gear when its size is only 1.25 x 2.0 x .4 inches and it comes with our etched in stone, legendary, one year warranty.

Instead of sifting through the field...searching, use our super quick one day delivery and cash in on a rare find.



\$59.95 each

COMMUNICATIONS SPECIALISTS

426 W. Taft Ave., Orange, CA 92665-4296
Local (714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. 1-800-854-0547



Circle (3) on Fast Fact Card